Small-bodied Fishes Monitoring in the San Juan River: 2015

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EXECUTIVE SUMMARY

In 2015, annual small-bodied fishes monitoring occurred from Bloomfield, NM (River Mile [RM] 196.1) to Clay Hills, UT (RM 2.9). River-wide, 111 sites were sampled, 65 in the primary channel, 38 in secondary channels, and 8 in large backwaters. A total of 1,662 fish, representing 15 different species, 5 native and 10 nonnative, were captured river-wide during sampling. This is the lowest number of fishes captured during monitoring since 2007, although 80% of all captured fish were native. Densities differed between reaches with the lowest densities occurring in Reaches 1 and 2 (1.3 fish/100 m^2), and the highest density occurring in Reach 7 (29.3 fish/100 m^2).

Similar to previous years, captures of rare and endangered native fish were low. Nineteen Colorado Pikeminnows *Ptychocheilus lucius* were captured river-wide, but densities were greatest in Reaches 5 and 6. The greatest number of captures occurred in the primary channel (N = 12), followed by secondary channels (N = 6), and large backwaters (N = 1). A single, wild age-0 Colorado Pikeminnow was captured in 2015, the first ever during small-bodied fishes monitoring. This fish was captured in a large backwater at RM 133.5 and had a total length of 18 mm (metalarvae stage). Total length (TL) of all captured Colorado Pikeminnow, excluding the 18 mm age-0 fish, averaged 144 mm and ranged from 107 to 245 mm. Although three Razorback Suckers *Xyrauchen texanus* were also captured during 2015 monitoring, all fish were large (> 405 mm TL), and had been stocked during previous population augmentation efforts. To date, no age-0 or juvenile Razorback Sucker have been captured during small-bodied fishes monitoring. No Roundtail Chub *Gila robusta* or Mottled Sculpin *Cottus bairdi* were captured in 2015.

The number of fishes captured in 2015 was lower than previous years, and many common species were observed at their lowest densities since 2007. Within the common sampling area (Reaches 3 – 6), statistically significant decreasing trends in densities were also observed for several native and nonnative species. Trends in density were not analyzed for species captured in Reaches 1 and 2 or Reach 7 due to the lack of long-term data, although densities in these reaches were lower than those observed in prior years. For the second year in a row, the majority of River Ecosystem Restoration Initiative (RERI) restored secondary channels were dry and consequently not sampled. Fish density in both RERI and reference secondary channels were low, although the densities of native fishes were higher than nonnatives in 2015. Since 2012, species diversity in RERI channels has decreased, likely due to fewer nonnative species being captured in these secondary channels.

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INTRODUCTION

In 1991, a 7-year research period was initiated to gather baseline information on federally endangered Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus* after both species were re-discovered and documented spawning in the San Juan River. In 1992, a Cooperative Agreement between the U.S. Fish and Wildlife Service, States of Colorado and New Mexico, the Jicarilla Apache Indian Tribe, the Southern Ute Indian Tribe, and the Ute Mountain Ute Indian Tribe was signed to form the San Juan River Basin Recovery Implementation Program (SJRIP). The Navajo Nation later signed the Cooperative Agreement and joined the SJRIP in 1996. The purpose of the SJRIP is to conserve populations of Colorado Pikeminnow and Razorback Sucker in the San Juan River Basin while water development proceeds in the basin in compliance with all federal, state, and tribal laws (SJRIP 2015). The research program was incorporated into the SJRIP when it was formed in 1992.

After the 7-year research period ended, the SJRIP initiated several management actions to aid in endangered species recovery including mechanical control of nonnative species, habitat restoration, population augmentation, and the implementation of flow recommendations. To assess the effects of these management actions on endangered fish recovery and the native fish community as a whole, a long-term monitoring program was initiated in 1998. The goals of this monitoring program were to: (1) track the status and trends of endangered and other fish populations in the San Juan River, (2) track changes in abiotic parameters important to the fish community, and (3) utilize collected data to help assess progress towards recovery of endangered fish species (Propst et al. 2006). The SJRIP Long-Range Plan specifies that monitoring and evaluation of fish in the San Juan River is a necessary element for assessing the progress of the recovery program for Colorado Pikeminnow and Razorback Sucker (Element 4; SJRIP 2015).

Task 4.1.2.2 of the SJRIP's Long-Range Plan specifies the need for juvenile and small-bodied fishes monitoring to locate areas and habitats used for rearing and to determine if young fish are surviving and recruiting into adult populations (SJRIP 2015). Data collected during annual small-bodied fishes monitoring can be used to assess recovery of Colorado Pikeminnow and Razorback Sucker. In addition to assessing recovery of both endangered fish species, small-bodied monitoring data have also been used to evaluate the influences of SJRIP management actions on the river's fish community as a whole. These assessments have included evaluating the effects of flow regime management on small-bodied fishes in secondary channels (Propst and Gido 2004; Franssen et al. 2007; Gido and Propost 2012; Gido et al. 2012), assessing the influences of habitat stability on the spatial and temporal trends in small-bodied fish communities in secondary channels (Gido et al. 1997), and determining the effects of habitat heterogeneity on the community structure of small-bodied fishes (Franssen et al. 2015).

The goal of small-bodied monitoring is to quantitatively assess the effects of management actions on survival of post-larval early life stages of native and nonnative fishes and their recruitment into subsequent life stages and use this information to recommend appropriate modifications to recovery strategies for Colorado Pikeminnow and Razorback Sucker in the San Juan River (SJRIP 2012). The specific objectives for small-bodied fishes monitoring are: (1) annually document occurrence and density of native and nonnative age-0/small-bodied fishes in the San Juan River; (2) document mesohabitat use by age-0 Colorado Pikeminnow, Razorback Sucker, and Roundtail Chub, as well as other native and nonnative fishes in the primary channel, secondary channels, and large backwaters; (3) obtain data that will aid in the evaluation of the responses of native and nonnative fishes to different flow regimes and other management actions; (4) track trends in native and nonnative species populations; and (5) characterize patterns of mesohabitat use by native and nonnative small-bodied fishes.

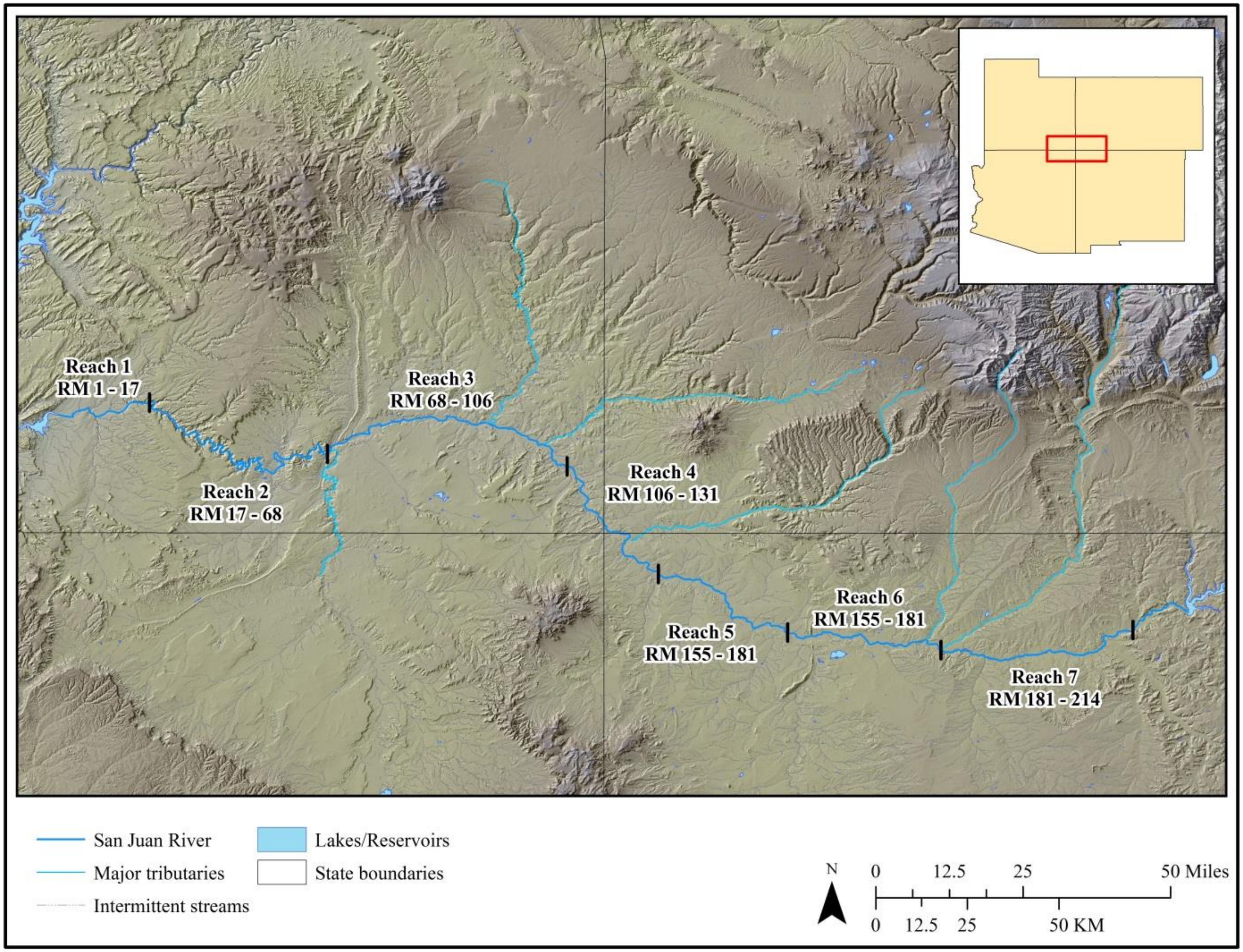


Figure 1. Map of the San Juan River indicating location of geomorphic reaches and river miles (RM). Map insert indicates the location of the San Juan River in the states of Colorado, New Mexico, and Utah.

STUDY AREA

The San Juan River is a major tributary of the Colorado River and begins in the San Juan Mountains of southwestern Colorado. The river is heavily influenced by Navajo Dam, located at River Mile (RM) 224 in New Mexico, and by Lake Powell in Utah (Figure 1). Over the 224 river miles between Navajo Dam and Lake Powell, the San Juan River changes dramatically and has been classified into eight different geomorphic reaches based on several datasets analyzed by Bliesner and Lamarra (2000). The upper three Reaches, 8 (RM 224 - 213), 7 (RM 213 - 181), and 6 (RM 180 - 155) have been heavily influenced by anthropogenic modifications and the river in this area is predominately a single channel. The middle portion of the river, Reaches 5 (RM 151 – 131), 4 (RM 130 – 107), and 3 (RM 106 – 68) are braided with multiple side channels and a broad floodplain. The lower two Reaches, 2 (RM 67 – 17) and 1 (RM 16 – 0) are canyon bound, and Reach 1 is heavily influenced by Lake Powell.

Since small-bodied fishes monitoring began in 1998, sampling has annually occurred downstream of the confluence with the Animas River (RM 180.5), but some alterations to the spatial extent of monitoring have occurred over time (Figure 2). From 1999 to 2010, annual monitoring occurred from the Animas River confluence (RM 180.5) downstream to Clay Hills Crossing, UT (RM 2.9). Beginning in 2011, annual sampling downstream of Sand Island, UT (RM 76.4) ceased, and now occurs only once every five years. In 2012, monitoring was extended upstream of the Animas River confluence to Bloomfield, NM (RM 196.1), an additional 15.5 miles of river. Since 1999, only Reaches 3 – 6 have been sampled every year (Figure 2).

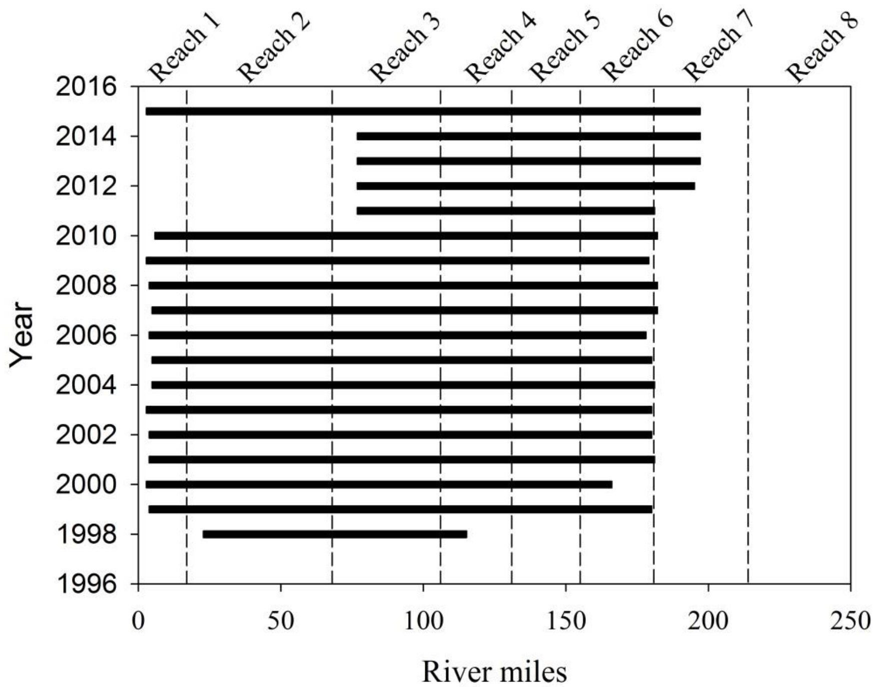


Figure 2. Spatial extent of sampling during small-bodied fishes monitoring on the San Juan River from 1998 – 2015. Note that river miles begin (River Mile 0) at the inflow to Lake Powel in Utah and end at Navajo Dam (River Mile 224) in New Mexico.

METHODS

Sampling protocol

Small-bodied fishes sampling occurred in September in conjunction with sub-adult and adult monitoring. The primary channel was sampled at designated 3-mile intervals, skipping the miles sampled by sub-adult and adult monitoring crews (SJRIP 2012). All secondary channels (less than 20% of total flow) and large backwaters (> 50 m^2) were sampled when encountered, regardless if they occurred within a designated 3-mile interval or not. All primary channel sample sites were approximately 200 m long (measured along the shoreline). Lengths of secondary channel and large backwater sample sites varied depending upon extent of surface water but were normally 100 – 200 m long.

At each sampling site, the river mile, geographic coordinates (UTM NAD83), and water quality parameters (dissolved oxygen, conductivity, and temperature) were recorded. All mesohabitats (e.g., riffle, run, pool) present within a site (except large backwaters) were sampled in rough proportion to their availability using a 3.0 x 1.8 m (3.0 mm heavy duty Delta untreated mesh) drag seine. Uncommon mesohabitats (e.g., debris pools and backwaters) were sampled in greater proportion to their availability than common mesohabitats. Typically seine hauls were made in at least five different mesohabitats at each site; however, if habitat was homogeneous, as few as three seine hauls were made. At least two seine hauls, one across the mouth and one parallel to its long axis were made at each large backwater unless the backwater mouth was too narrow in which case at least one seine haul, parallel to the backwaters long axis, was made. Types and descriptions of mesohabitats sampled during small-bodied fishes monitoring in the San Juan River are given in Table 1.

All captured fishes were identified to species and measured for total length (mm TL) and standard length (mm SL). All native fishes were released and nonnative fishes removed from the river. Fishes too small to easily identify in the field were fixed in 10% formalin and returned to the laboratory. After collection of fish, the sampled width and length of each mesohabitat was measured to the nearest 0.1 m and recorded. The depth and dominant substrate at five generalized locations, and any cover (e.g., boulders, debris piles, large woody debris) associated with the mesohabitat were also recorded.

Retained specimens were identified and measured (TL and SL) in the laboratory to the nearest 0.1 mm. Personnel at the University of New Mexico Museum of Southwestern Biology (UNM-MSB), Division of Fishes, and personnel from American Southwest Ichthyological Researchers assisted in verification of fish identifications in the laboratory. All retained specimens were accessioned to the UNM-MSB, Division of Fishes.

Data Analysis

Daily mean discharge in cubic feet/second (cfs) was obtained from the U.S. Geological Survey stream gage at Shiprock, NM (Gage 0936800; data available: http://waterdata.usgs.gov/nwis/rt). Several discharge metrics were calculated for the spring (1 March – 30 June) and summer (1 July – 30 September) time periods for each year beginning in 2007. Density of fishes for each individual seine haul was calculated as the number of fish captured per square meter (sampled width x sampled length) and then transformed to fish per 100 m^2. To facilitate comparisons among years, data were grouped by channel type (i.e., primary, secondary, large backwater) and similar geomorphic reaches (i.e., 1 and 2, 3 – 6, and 7) to account for differences in temporal and spatial sampling frequencies (Figure 2). Total density, total fishes captured divided by total area sampled, for each reach group and channel type was calculated to allow comparisons of overall density among years. Assessment of trends in densities by channel type and species were determined using simple linear regression. To ensure that data met the assumptions of linear regression, a Shapiro-Wilk test ($\alpha = 0.05$) was used to assess normality and scatter plots were used to assess homoscedasticity.

Table 1. Definitions of mesohabitats typically sampled during small-bodied fishes monitoring in the San Juan River. Definitions from Bliesner et al. 2009.

Mesohabitat	Definition
Backwater	Typically a body of water off-channel in an abandoned secondary mouth, behind a bar or in a bank indention, water depth from < 10 cm to > 1.5 m, no perceptible flow, substrate typically silt or sand and silt. Little or no mixing of backwater and channel water.
Pool	Area within channel where flow not perceptible or barely so; water depth usually ≥ 30 cm; substrate silt, sand, or silt over gravel, cobble, or rubble.
Eddy	Same as pool, except water flow is evident (but slow) and direction typically opposite that of channel or circular.
Shoal	Generally shallow (≤ 25 cm) areas with laminar flow (very slow to slow velocity: ≤ 5 cm/sec) over sand or cobble substrate.
Run	Typically moderate or rapid velocity water 10-30 cm/sec with little or no surface disturbance. Depths usually 10-74 cm but may exceed 75 cm. Substrate usually sand but may be silt in slow velocity runs and gravel or cobble in rapid velocity runs.
Riffle	Area within channel where gradient is moderate (5 cm/m), water velocity usually moderate to rapid (10 to 31 cm/sec), and water surface disturbed. Substrate usually cobble and rubble and portions of rocks may be exposed. Depths vary from < 5 to 50 cm, rarely greater.
Chute	Rapid velocity (≥ 30 cm/sec) portion of the channel (often near center) where gradient ≥ 10 cm/m. Channel profile often U- or V-shaped. Depth typically ≥ 30 cm. Substrate large cobble or rubble and often embedded.
Slackwater	Low velocity habitat usually along inside margin of river bends, shoreline invaginations, or immediately downstream of debris piles, bars, or other in-stream features, but deeper than shoals (> 25 cm).
Isolated pool	Small body of water in a depression, old backwater, or side channel, not connected to the channel as a result of receding flows.
Embayment	Open shoreline depression similar to a backwater but that faces upstream. Typically at the top end of abandoned secondary channels or bars.
Rapid	Deep, high gradient, high velocity areas often with standing waves.
Pocket water	Low velocity water similar to slack water, but in boulder fields. These usually occur in channel margins in the canyon reaches.
Plunge	The transition area below a riffle or chute where the channel deepens into a run with transition from high to low velocity.

Differences between 2015 densities and the previous 8-year densities were determined using the Wilcoxon signed-rank test. Changes in densities over time for native and common nonnative species for each channel type were analyzed using the Kruskal-Wallis ANOVA. Statistically significant differences ($\alpha < 0.10$) were then analyzed using a post hoc Dunn's test and a Mann-Kendall test was then used to determine statistically significant trends. Analysis of trends for individual species was restricted to data collected in Reaches 3 – 6 due to the limited temporal availability of data from Reaches 1 and 2 and Reach 7. Due to the natural variability often observed in age-0 fish populations an α of 0.10 was used to determine statistically significant differences or trends (Brown and Guy 2007). All statistical analyses were performed using R 3.2.1 (R Core Team 2015).

Due to limited data for the River Ecosystems Recovery Initiative (RERI) and reference secondary channels, detailed statistical analyses were not conducted for these sites. However, information and observations for samples taken at these sites are included below. Density of native and nonnative fish were calculated for each site type (i.e., RERI or Reference) and each year, along with Shannon's Diversity Index (H') and Evenness Based on Shannon's Diversity Index (J'). The Shannon's Diversity Index was calculated as $H' = -\sum_{i=1}^{S}(p_i)(log_e p_i)$,, and Evenness Based on Shannon's Diversity Index was calculated as $J' = \frac{H'}{H'_{max}} = \frac{H'}{log_e S}$ (Shannon and Weaver 1949).

RESULTS

In 2015, sampling occurred from RM 196.1 (Bloomfield, NM) to RM 2.9 (Clay Hills, UT), the greatest spatial extent of sampling that has occurred during small-bodied fishes monitoring (Figure 2). Sixty-five primary channel sites (17,775 m^2), 38 secondary channels (6,076 m^2), and eight large backwaters (705 m^2) were sampled (Figure 3). The greatest number of sampled secondary channel and large backwater sites occurred in Reaches 3 – 6. A total of 1,662 fishes were captured river-wide, approximately 80% of which were native (Table 2). In comparison to the previous eight years (2007 – 2014), 2015 had the lowest number of fishes captured, even though the longest spatial extent ever sampled in a single year also occurred in 2015. No Roundtail Chub *Gila robusta* or Mottled Sculpin *Cottus bairdi* were captured during 2015 monitoring.

Table 2. The total number (N) of all fishes, native fishes, percent (%) native fishes, and number of Colorado Pikeminnow, Razorback Sucker, Roundtail Chub, and Mottled Sculpin captured during small-bodied fishes mointoring in the San Juan River from 2007 to 2015.

Year	Total (N)	Native (N)	Native (%)	Colorado Pikeminnow (N)	Razorback Sucker (N)	Roundtail Chub (N)	Mottled Sculpin (N)
2007	4,851	3,367	69.4	59			
2008	4,552	2,800	61.5	10			
2009	12,407	4,800	38.7	12			
2010	5,844	4,288	73.4	49			
2011	7,479	2,975	39.8	61		1	
2012	5,382	2,501	46.5	27		2	1
2013	5,073	4,186	82.5	15	1		1
2014	2,227	1,699	76.3	28		2	
2015	1,662	1,335	80.3	19	3		

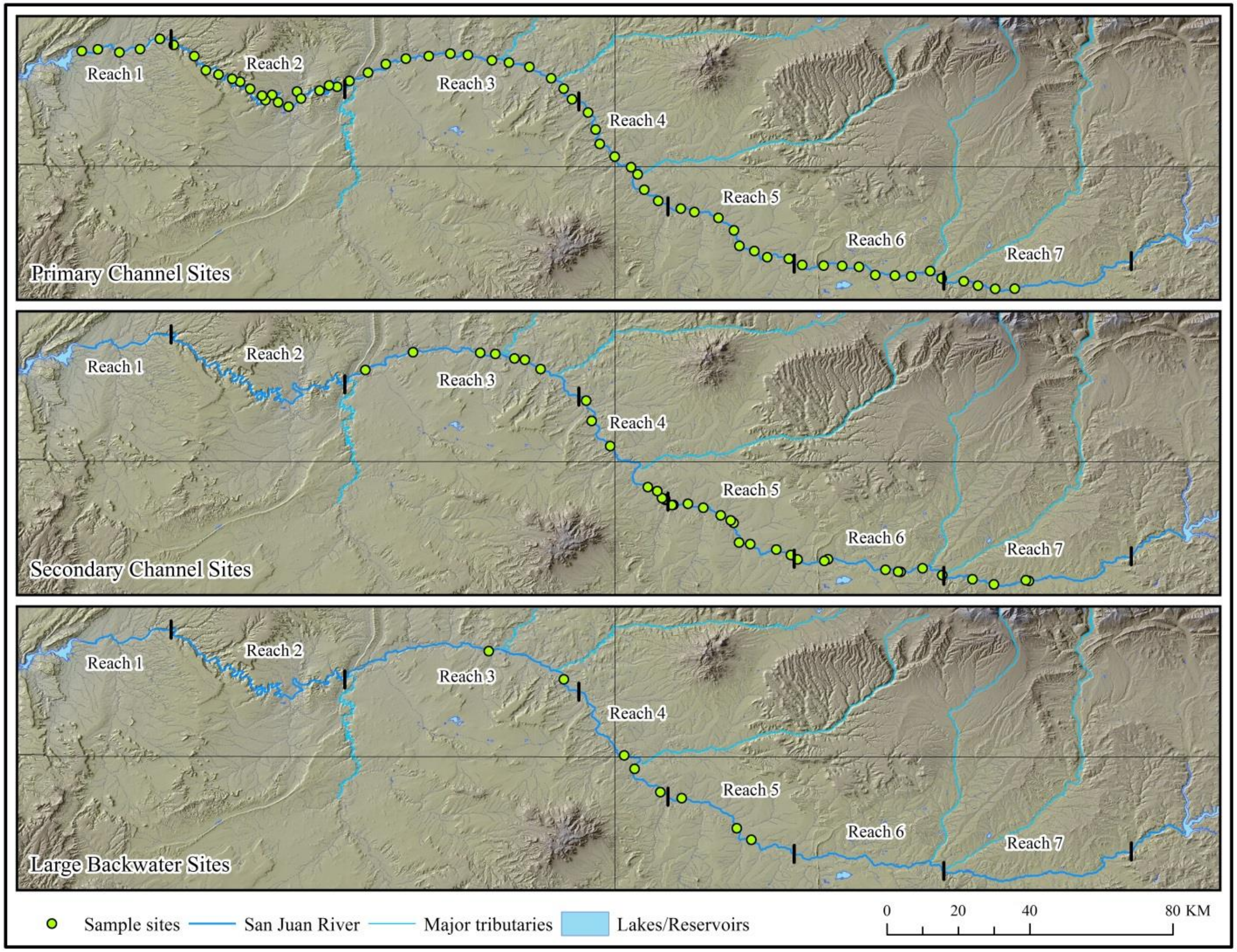


Figure 3. Location of primary channel sites (top), secondary channels (middle), and large backwaters (bottom) sampled during small-bodied fishes monitoring on the San Juan River in 2015.

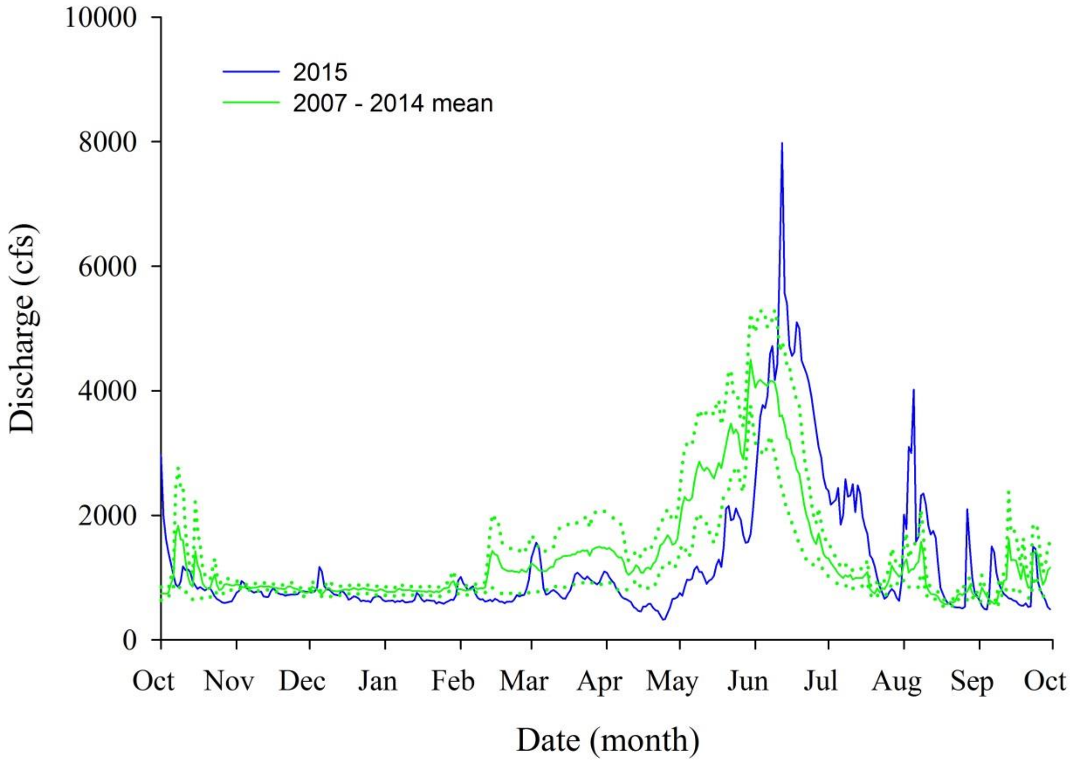


Figure 4. Mean daily discharge during the 2015 (blue line) water year (1 October to 30 September) and eight year (2007 – 2014) mean daily discharge of the San Juan River at Shiprock, NM (USGS gage 09368000). Dotted lines indicate ± 1 standard error of the 2007 – 2014 mean.

Discharge Data

Discharge at Shiprock, NM during the 2015 water year (1 October – 30 September; WY) was similar to the 2007 - 2014 mean discharge (Figure 4), except spring runoff peaked at a much higher discharge (7,980 cfs). Mean spring discharge was similar to most years since 2007, but the river remained above 3,000 cfs for a total of 26 days, significantly longer than most years prior to 2015 (Appendix I). Discharge during the summer averaged 1,277 cfs, the highest observed since 2007. In addition, the river remained above 1,000 cfs for a total of 43 days, a much longer period of time in comparison to other years since 2007. Summer mean discharge was also highly variable, with large peaks occurring in both August and September (Figure 4).

Reaches 1 and 2

Sampling in Reaches 1 and 2 last occurred in 2010 and will not occur again until 2020. In 2015, no secondary or large backwaters were encountered during sampling and only the primary channel (21 sites; 6,925 m^2) was sampled (Figure 3). A total of 91 fishes comprising five different species (3 native and 2 nonnative) were captured during sampling in Reach 1 and 2. Due to lack of data from 2011 – 2014 and because no secondary or large backwaters were sampled in 2015, species trends were not analyzed and only comparisons of primary channel observations taken in 2015 were made to previous years (2007 – 2010).

Ninety-one fishes were captured in the primary channel in 2015, 15.4% of which were native (Figure 5A). Total density in the primary channel was 1.31 fish/100 m^2, the lowest density observed since 2007 (Figure 5B). Speckled Dace *Rhinichthys osculus* (median density = 0.0 fish/100 m^2, range = 0.00 – 13.1

fish/100 m^2) was the most common native fish captured in Reaches 1 and 2, comprising 78.6% of all native fishes. However, the density of Speckled Dace was significantly lower in 2015 in comparison to 2007 – 2010 densities (median = 0.0 fish/100 m^2, range = 0.0 – 71.8 fish/100 m^2; Wilcoxon signed-rank test, $P < 0.01$). Only two other native fish species were captured in Reaches 1 and 2, one Flannelmouth Sucker *Catostomus latipinnis* and two Colorado Pikeminnows. The density of Flannelmouth Sucker (median = 0.0 fish/100 m^2, range = 0.0 – 2.2 fish/100 m^2) was significantly lower in 2015 than in comparison to 2007 – 2010 densities (Wilcoxon signed-rank test, $P = 0.09$). The 2015 density of Colorado Pikeminnow (median 0.0 fish/100 m^2, range = 0.00 – 14.7 fish/100 m^2) was similar to those observed from 2007 – 2010 (median = 0.00 fish/100 m^2, range = 0.00 – 14.7 fish/100 m^2; Wilcoxon signed-rank test, $P = 0.49$. Channel Catfish *Ictalurus punctatus* comprised the greatest proportion of nonnative (98.7%) and total fishes (83.5%) in the primary channel. Density of Channel Catfish (median 0.0 fish/100 m^2, range = 0.00 – 22.2 fish/100 m^2) was significantly lower in 2015 than 2007 – 2010 densities (median 0.00 fish/100 m^2, range = 0.00 – 243.1 fish/100 m^2; Wilcoxon signed-rank test, $P < 0.01$). In comparison to 2007 – 2010, no Red Shiners *Cyprinella lutrensis* were captured in these two Reaches, a significant deviation from prior years when the species averaged approximately 23.1% of all fishes captured.

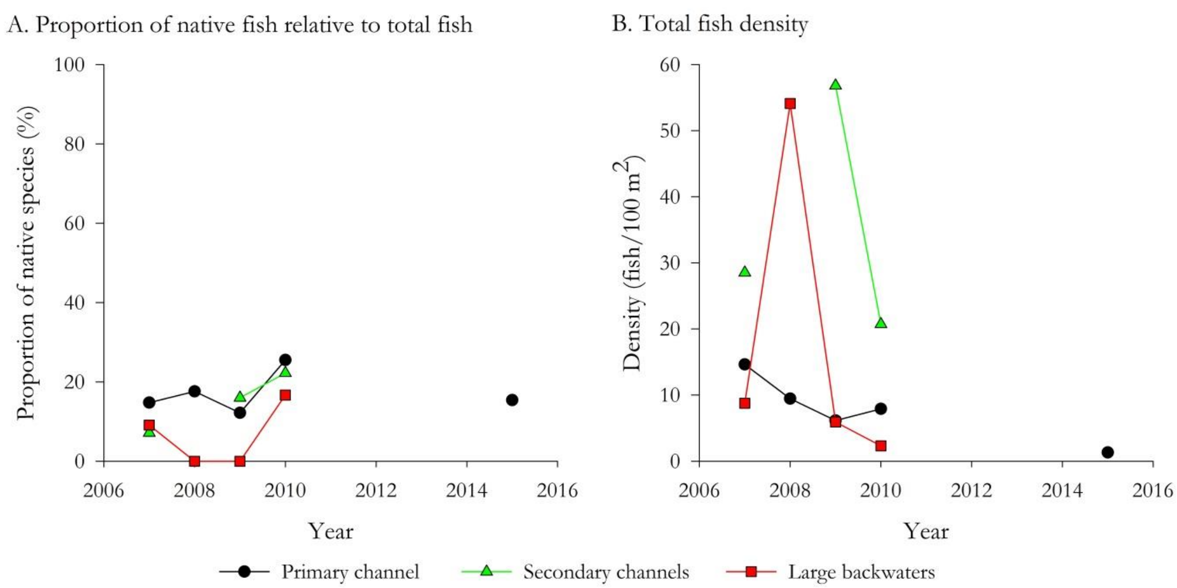


Figure 5. The (A) proportion (%) of native fishes and (B) total density (100 fish/m^2) of fishes captured in the primary channel (black circles), secondary channels (green triangles), and large backwaters (red squares) during small-bodied fishes monitoring in Reaches 1 and 2 of the San Juan River from 2007 – 2015. Note that Reach 1 and 2 were not sampled from 2011 – 2014, no secondary channels were sampled in 2008 and 2015, and no large backwaters were sampled in 2015.

Reaches 3 – 6

Sampling in Reaches 3 – 6 occurred at 38 primary channel sites (9,902 m^2), 34 secondary channels (5,568 m^2), and eight large backwaters (705 m^2) in 2015 (Figure 3). The total of 1,144 fishes captured from all channel types within these reaches was lower than in the previous eight years (2007 – 2014). Fifteen different species were captured, and approximately 80% of all captured fishes were native, the highest percentage ever. Total fish density for Reaches 3 – 6 was 7.1 fish/100 m^2, the lowest observed density in the previous eight years (median = 46.3 fish/100 m^2, range = 9.9 – 132.0 fish/100 m^2).

A total of 625 fishes were captured in primary channel sites, the lowest number of fishes captured since 2007. Approximately 78% of fishes captured in primary channel sites were native, the third highest percentage since 2007 (Figure 6A). Primary channel fish total density (6.31 fish/100 m^2) was also the lowest observed in the previous eight years, and the density in primary channels has been significantly decreasing since 2007 (Figure 6B; Linear regression: $\beta = -0.07$, $R^2 = 0.37$, $P = 0.08$). Not surprisingly, a number of species commonly encountered in these Reaches were observed at their lowest densities in comparison to the previous eight years of data. Red Shiners, which often comprised the greatest number of captures and densities of nonnative fishes in these Reaches, were observed at their lowest number (N = 15) and densities (median 0.0 fish/100 m^2, range = 0.0 – 35.1 fish/100 m^2) in comparison to 2007 – 2014 (median = 0.0 fish/100 m^2, range = 0.0 – 2,142.9 fish/100 m^2; Wilcoxon signed rank test, $P < 0.01$). A similar pattern was observed for Channel Catfish which were also captured at their lowest number (N = 23) and densities (median = 0 fish/100 m^2, range = 0.0 – 15.7 fish/100 m^2) compared to 2007 – 2014 (median = 0 fish/100 m^2, range = 0.0 – 265.2 fish/100 m^2; Wilcoxon signed rank test, $P < 0.01$).

Three-hundred-eighty-seven fishes were captured in secondary channels during 2015, the lowest number captured since 2007. Approximately 87% were native, the highest proportion of native fish captured from 2007 – 2015 (Figure 6A). The total density (6.95 fish/100 m^2) of fishes captured in secondary channels in 2015 was also the lowest observed since 2007. Since 2007, a statistically significant negative trend in fish density in secondary channels has been observed (Figure 6B; Linear regression: $\beta = -0.09$, $R^2 = 0.49$, $P = 0.04$). Speckled Dace was the most common fish captured in secondary channels in Reaches 3 – 6, but density (median = 0.0 fish/100 m^2, range = 0.0 – 84.8 fish/100 m^2) in 2015 was still significantly lower than 2007 – 2014 densities (median = 2.7 fish/100 m^2; range = 0.0 – 980.4 fish/100 m^2; Wilcoxon signed-rank test: $P < 0.01$). Western Mosquitofish *Gambusia affinis* was the most common nonnative species captured in secondary channels in Reaches 3 – 6, and densities (median = 0.0 fish/100 m^2; range = 0.0 – 215.7 fish/100 m^2) in 2015 was similar to the previous eight years (median = 0.0 fish/100m^2, range = 0.0 – 1,100.5 fish/100 m^2; Wilcoxon signed-rank test: $P = 0.43$). Densities of Red Shiner (median = 0.0 fish/100 m^2; range = 0.0 – 11.1 fish/100 m^2) and Channel Catfish (median = 0.0 fish/100 m^2, range = 0.0 – 17.2 fish/100 m^2) were much lower than in previous years, and significantly lower than the previous eight years (Red Shiner 2007 – 2014 median = 0.0 fish/100 m^2; range = 0.0 to 2,381.0 fish/100 m^2; Wilcox signed-rank test: $P < 0.01$; Channel Catfish 2007 – 2014 median = 0.0 fish/m^2, range = 0.0 – 151.5 fish/100 m^2; Wilcox signed-rank test: $P < 0.01$).

Eight (705 m^2) large backwaters were sampled in 2015, with all sampled backwaters occurring in Reaches 3, 4, and 5 (Figure 3). A total of 132 fishes were captured in these large backwaters, the lowest number captured since 2007. Although the number of fishes captured in backwaters was much lower than previous years, approximately 67% of captured fishes were native species, the highest proportion observed over the previous eight years. Similar to primary and secondary channels in Reaches 3 – 6, total fish densities (0.1872 fish/m^2) were the lowest observed since 2007 but there has been no statistically significant change since 2007 (Figure 6B; Linear regression: $\beta = -0.09$, $R^2 = 0.04$, $P = 0.59$). This is the first time that native fishes outnumbered nonnative fishes in large backwaters since 2007. Similar to other years, the number of Colorado Pikeminnow captured in backwaters was low and only a single fish was captured in 2015.

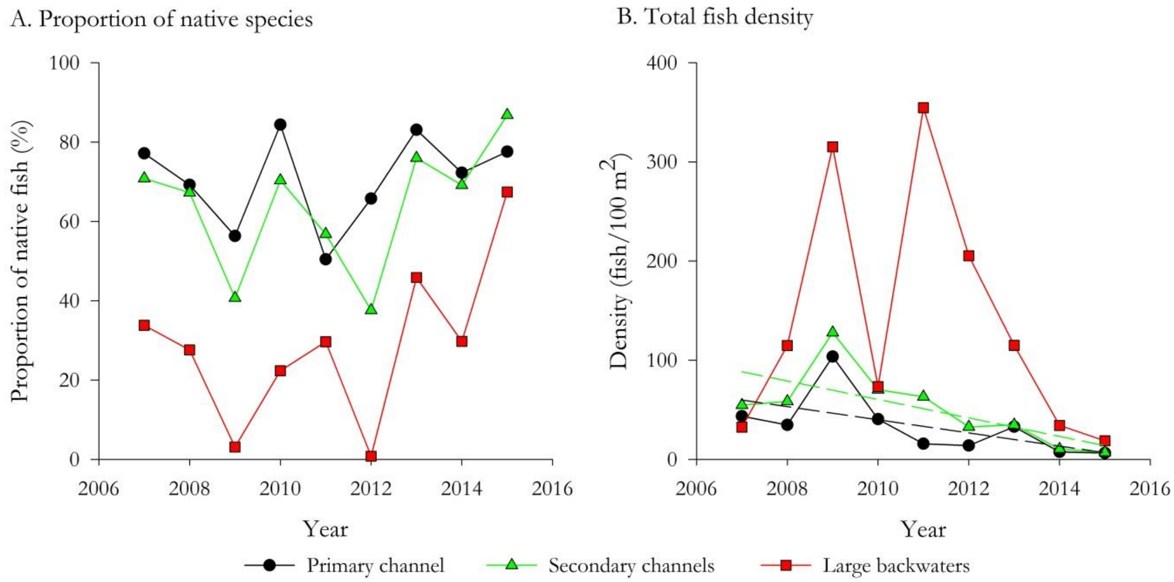


Figure 6. The (A) proportion (%) of native fishes and (B) total density (fish/100 m²) of fishes captured in the primary channel (black circle), secondary channels (green triangle), and large backwaters (red square) during small-bodied fishes monitoring in Reaches 3 - 6 of the San Juan River from 2007 – 2015. Dashed lines indicate statistically significant (P < 0.10) trends for each channel type.

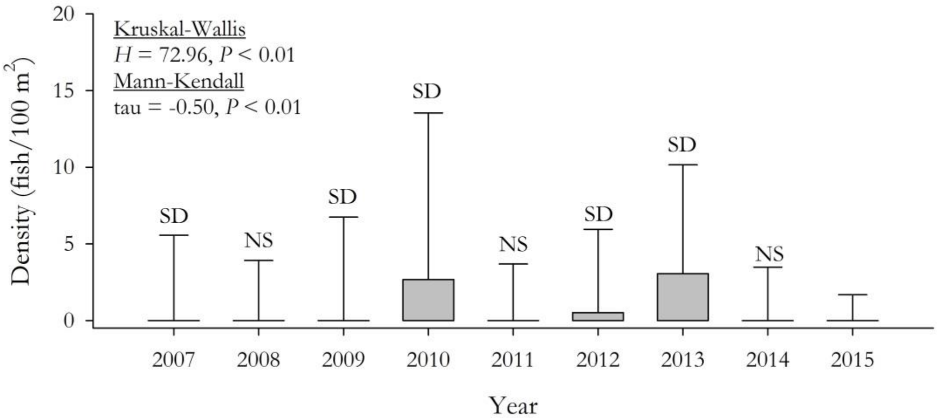
Species Trends by Channel Type

Densities of common native and nonnative fishes in Reaches 3 – 6 varied significantly from year to year and by channel type (i.e. primary, secondary, large backwaters) from 2007 – 2015 (Figure 7 – 15). In spite of high variation, densities of several species changed significantly from 2007. Flannelmouth Sucker showed statistically significant (Mann-Kendall: tau ≤ - 0.49, P < 0.01) declines in density since 2007 in the primary channel, secondary channels, and large backwaters (Figure 7). Densities of Flannelmouth Suckers in most years were not statistically different from 2015 densities though. Densities of Bluehead Suckers showed significant negative trends in both the primary channel and secondary channels from 2007 – 2015 (Mann-Kendall: tau < -0.50, P < 0.01; Figure 8). There was no significant difference between densities of Bluehead Suckers in large backwaters from 2007 – 2015, and thus no test for trend over time was conducted (Figure 8C). Significant declines in densities of Speckled Dace since 2007 were also evident in the primary channel and secondary channels (Mann-Kendall: tau < -0.45, P < 0.01; Figure 9). The 2015 densities of Speckled Dace were also the lowest ever observed except for 2014 in the primary channel and 2012 and 2014 in secondary channels. No difference in the densities of Speckled Dace in large backwaters was observed from 2007 – 2015 (Kruskal-Wallis ANOVA: H = 12.11, P = 0.15; Figure 9C). Since 2007, densities of Colorado Pikeminnow have decreased across all three channel types (Mann-Kendall: tau < -0.5, P < 0.10; Figure 10). Most years were not statistically significant from 2015 though, and the observed decreasing trends in Colorado Pikeminnow may not be biologically significant since most years densities were extremely low. The higher density of Colorado Pikeminnow in large backwaters observed in 2007 is likely biased due to the high number of captures which occurred after age-0 fish were recently stocked and subsequently captured (Paroz et al. 2008).

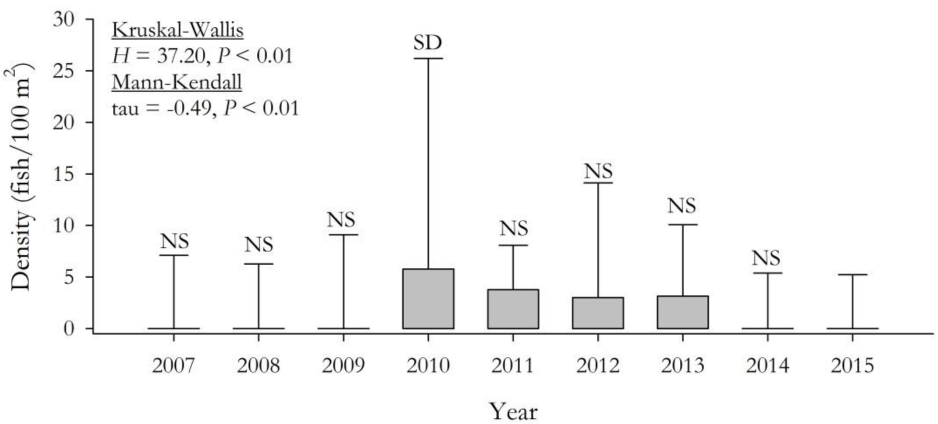
Similar to native species, densities of most common nonnative species have shown statistically significant declines since 2007 (Figure 11 – 15). Densities of Channel Catfish have decreased significantly since 2007 across all three channel types (Mann-Kendall: tau < -0.56, P < 0.01). Channel Catfish densities in

2015 were also significantly lower in comparison to previous years in both the primary channel and secondary channels (Figure 11). The density of Fathead Minnows has routinely been low in both the primary channel and secondary channels since 2007, although densities have been decreasing in both these channel types over time (Mann-Kendall: tau < -0.53, $P < 0.01$; Figure 12). There was no significant difference in densities between years in large backwaters though (Kruskal-Wallis ANOVA: $H = 8.45$, $P = 0.39$). Red Shiners have also shown significant declines in density since 2007 in the primary channel, secondary channels, and large backwaters (Mann-Kendall: tau < -0.55, $P < 0.01$; Figure 13). The densities of Red Shiners in 2015 were also among the lowest ever observed in the primary channel and secondary channels. Similar to Fathead Minnows, the densities of Western Mosquitofish have generally been low and highly variable across most years. Significant declines in their densities have occured since 2007 in the primary channel, secondary channels, and large backwaters though (Mann-Kendall: tau < -0.55, $P < 0.01$; Figure 13). Recent (2013 – 2015) densities of Fathead Minnows were also among the lowest ever observed.

A. Primary channel



B. Secondary channels



C. Large backwaters

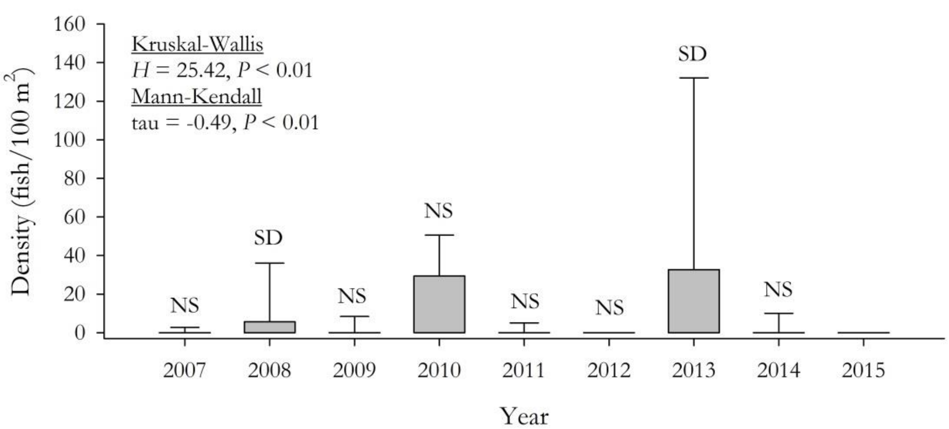
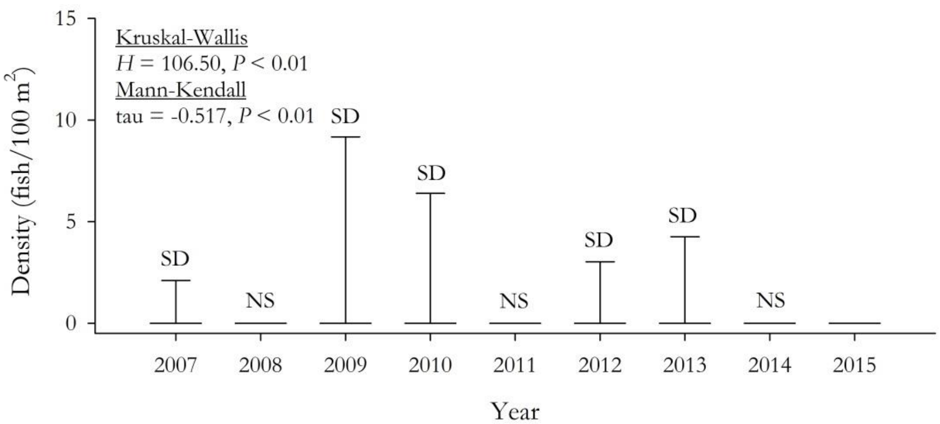
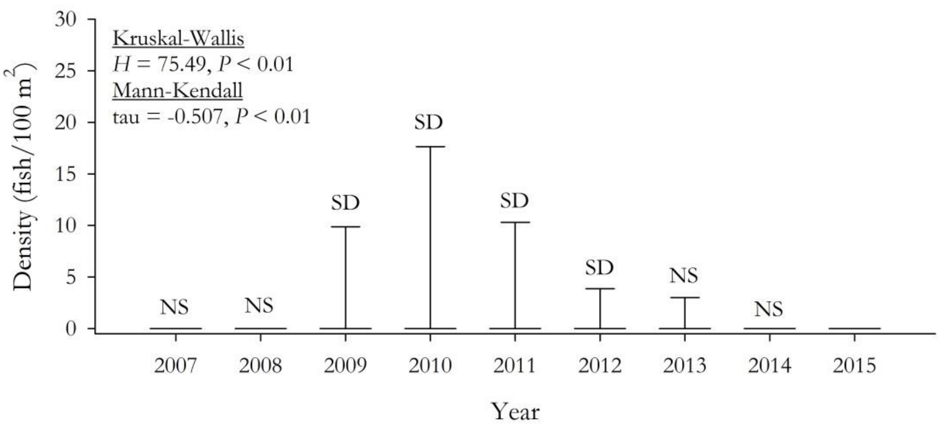


Figure 7. Box-whisker plots of densities of Flannelmouth Sucker in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

A. Primary channel



B. Secondary channels



C. Large backwaters

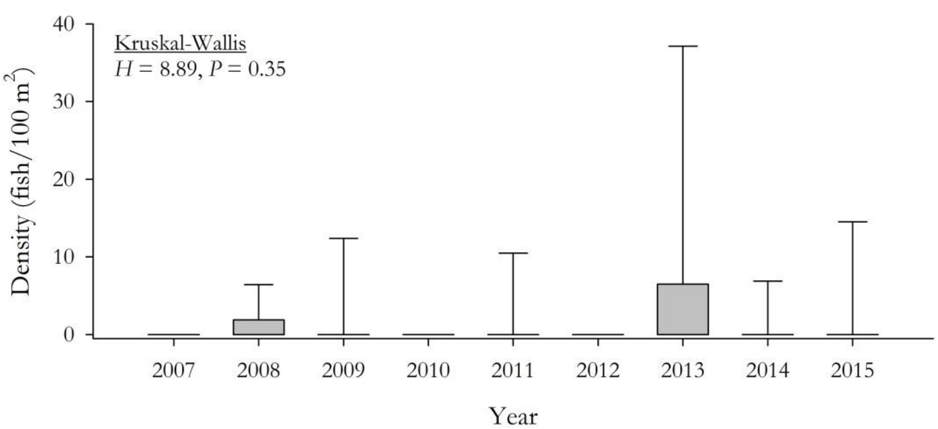


Figure 8. Box-whisker plots of densities of Bluehead Sucker in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

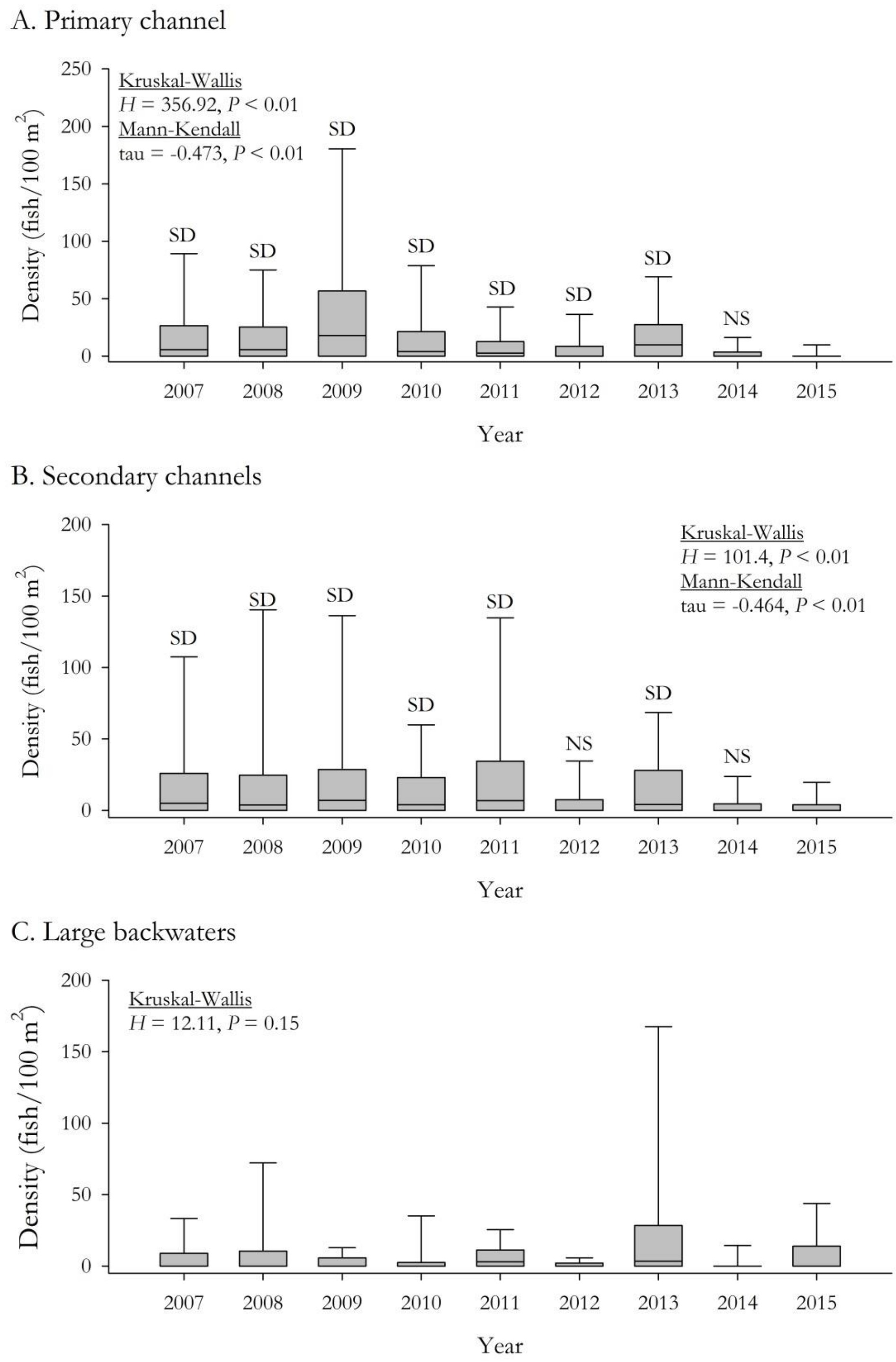


Figure 9. Box-whisker plots of densities of Speckled Dace in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

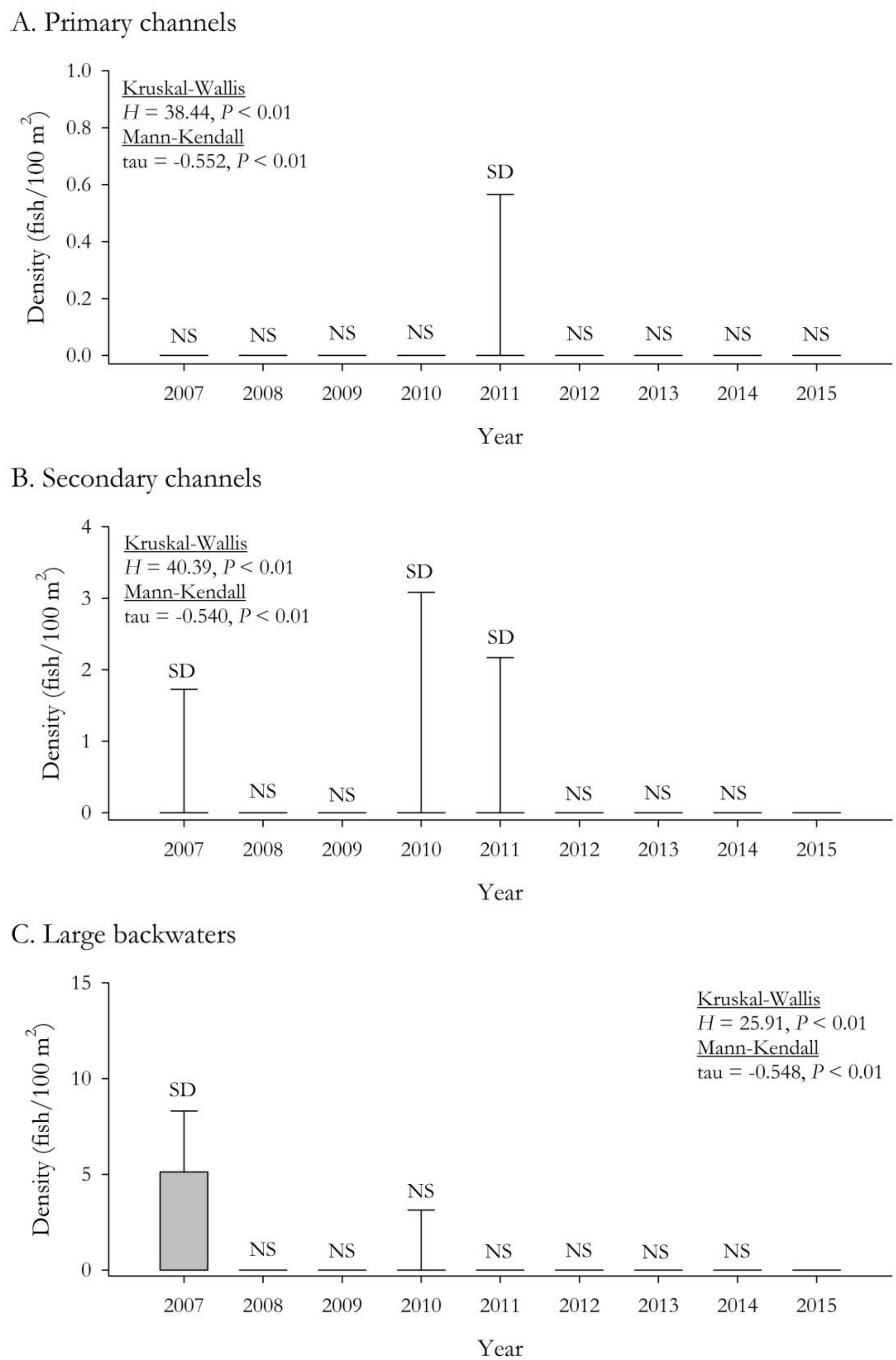


Figure 10. Box-whisker plots of densities of Colorado Pikeminnow in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

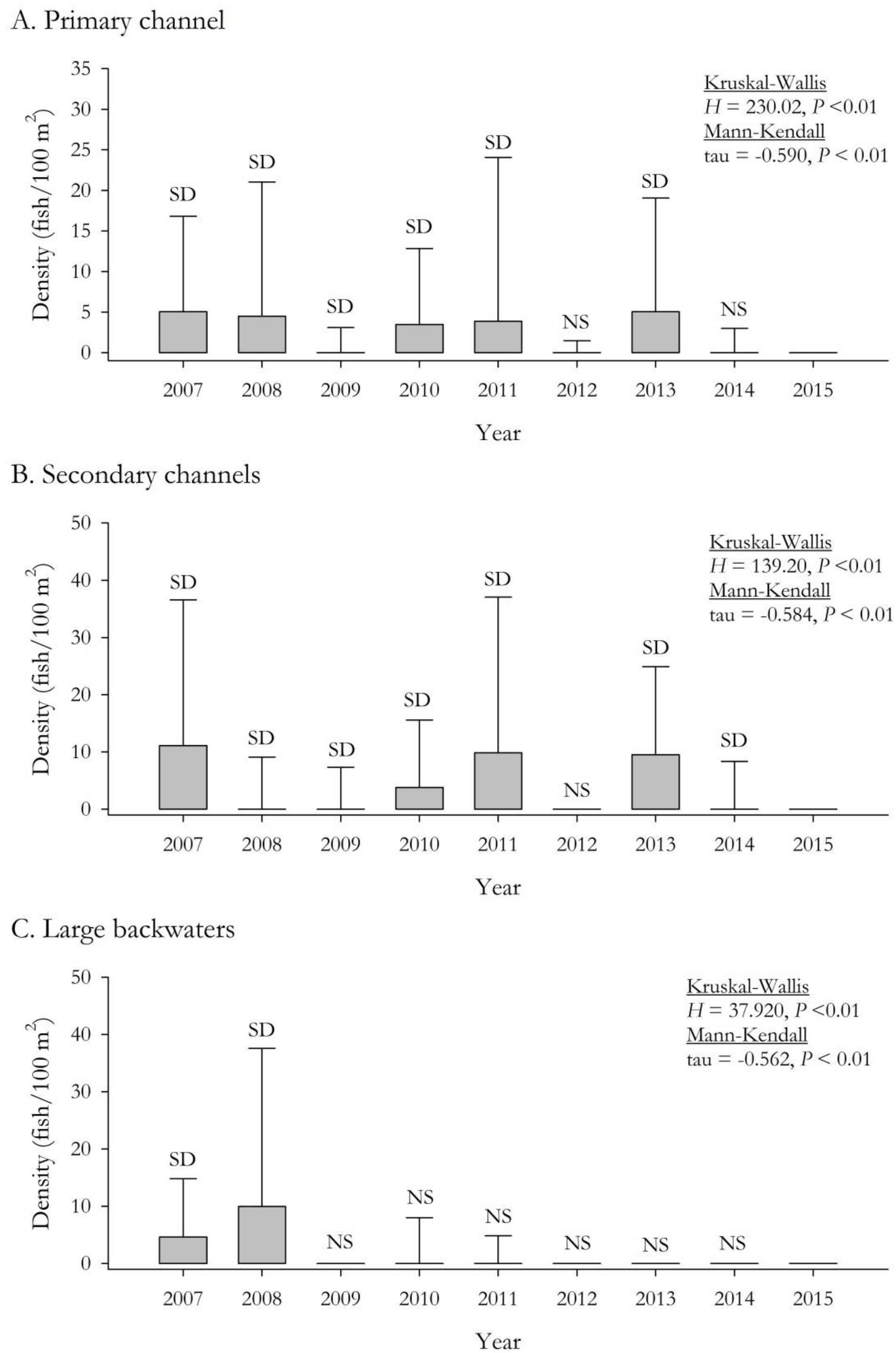


Figure 11. Box-whisker plots of densities of Channel Catfish in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

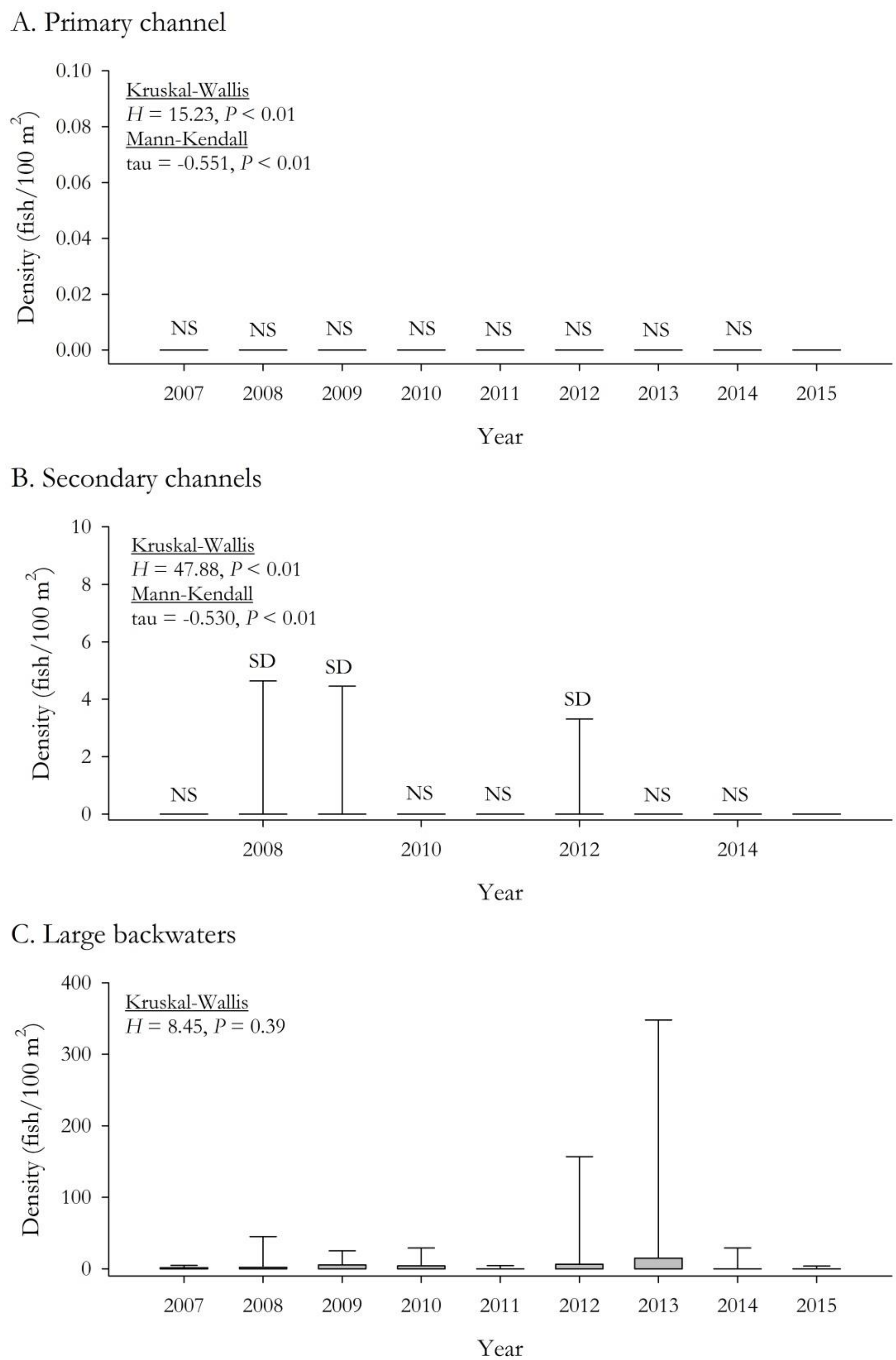


Figure 12. Box-whisker plots of densities of Fathead Minnows in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

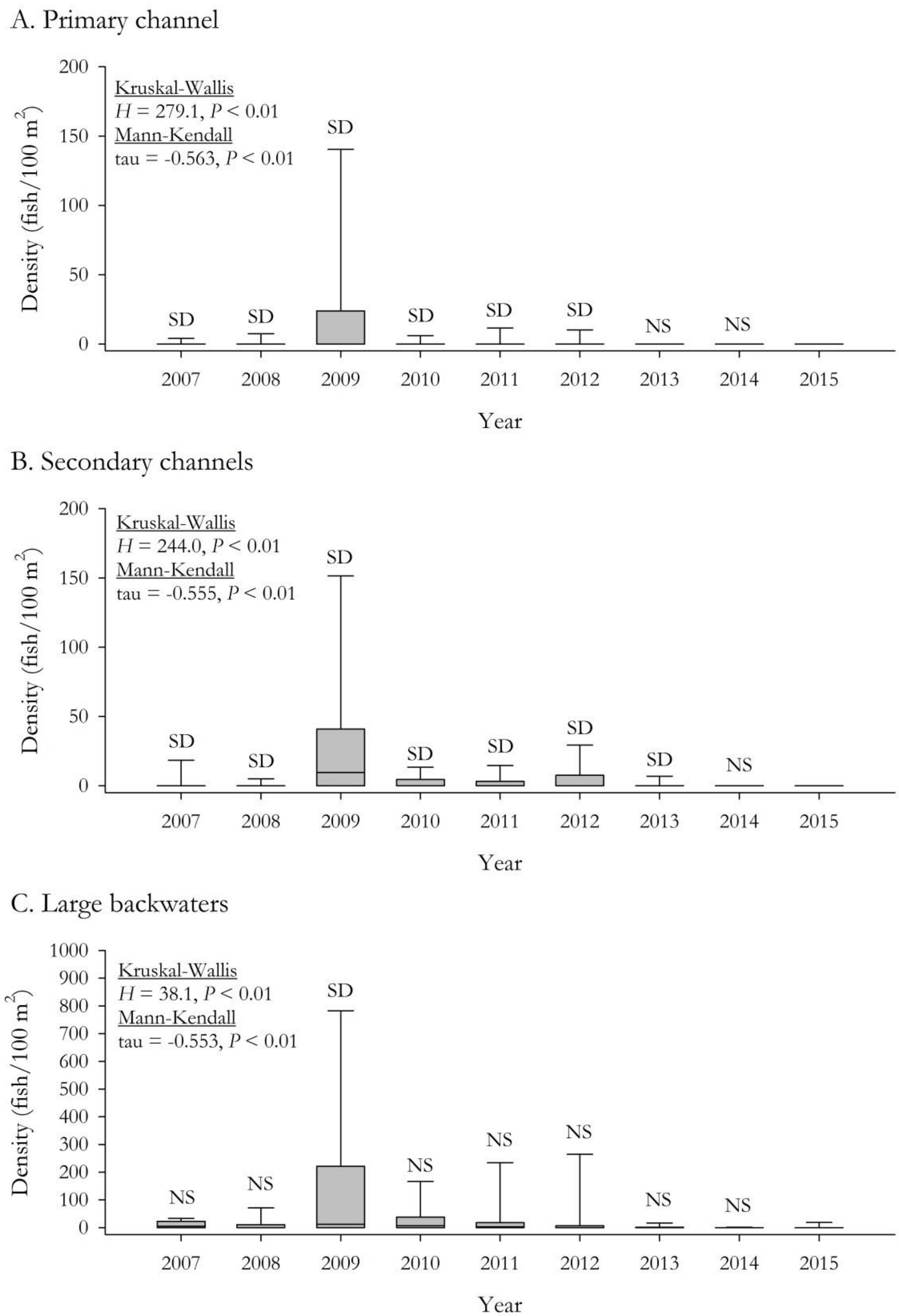


Figure 13. Box-whisker plots of densities of Red Shiners in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

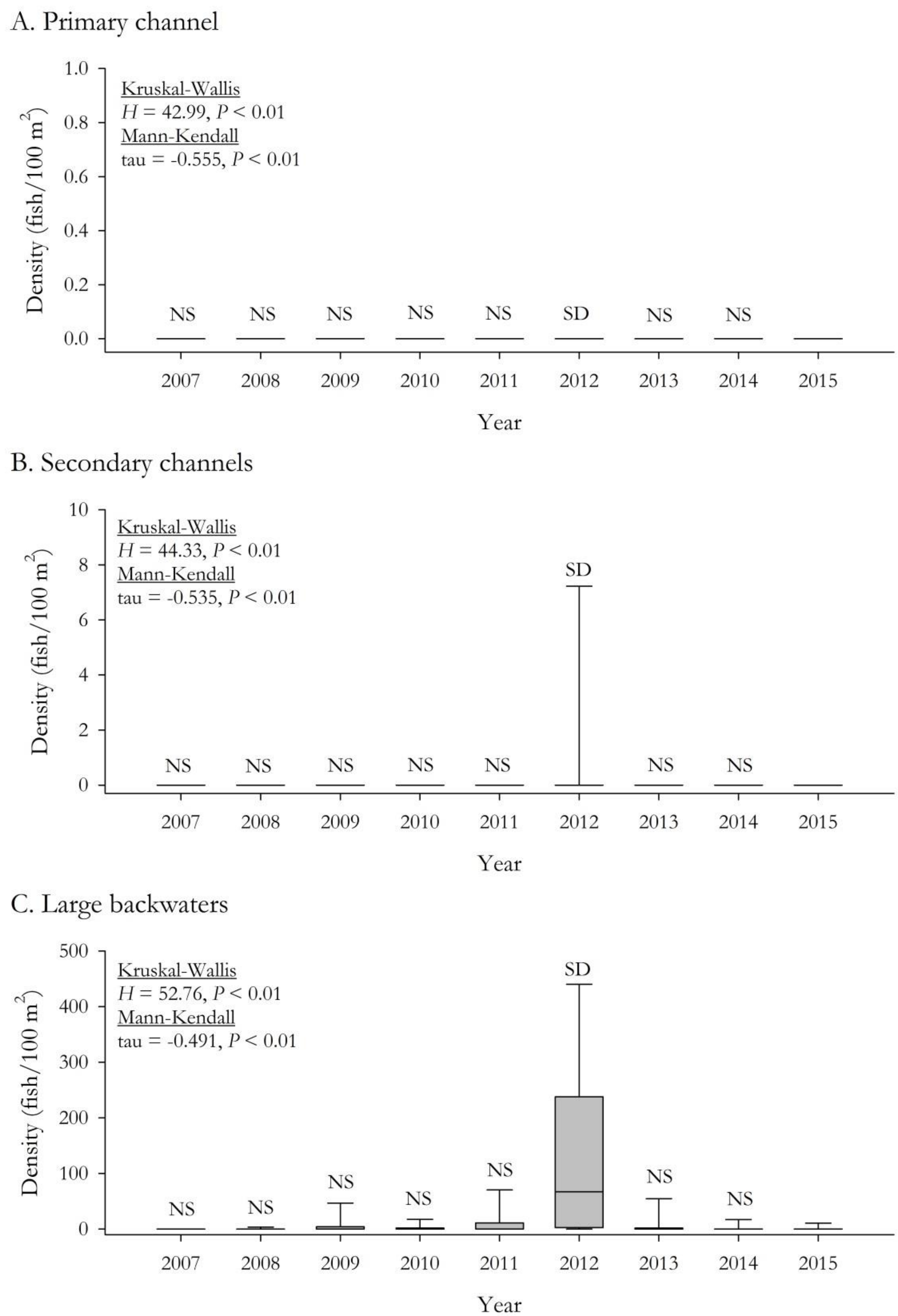


Figure 14. Box-whisker plots of densities of Western Mosquitofish in (A) the primary channel, (B) secondary channels, and (C) large backwaters (red) in Reaches 3 – 6 of the San Juan River from 2007 – 2015 with results of the Kruskal-Wallis ANOVA and Mann-Kendall tests. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. The symbols NS (not statistically significant) and SD (statistically significant difference) indicate whether or not previous years are different from 2015 based on the post-hoc Dunn's test. Note that Y-axis scales differ between graphs.

Reach 7

A total of five primary channel sites (total area 947 m²) and four secondary channels (total area 508 m²) were sampled in Reach 7 during 2015 (Figure 3). Only a single large backwater has ever been sampled (2012) since small-bodied monitoring in Reach 7 began in 2012, and none were encountered in 2015. In Reach 7, 427 fishes were captured comprising six different species. Approximately 96% of all captured fishes were native, the second lowest proportion of natives observed in this Reach since sampling began in 2012, although, the portion of natives is much higher in comparison to other sampled reaches.

Only 302 fishes were captured in the primary channel in 2015, the lowest number recorded since 2007. Native fishes greatly outnumbered nonnative fishes, comprising 98% of all fish captures (Figure 15A). Fathead Minnows *Pimephales promelas* were the only nonnative fish captured (N = 6). Total fish density (31.9 fish/100 m²) was the lowest observed in the previous four years (Figure 15B). Densities of Speckled Dace (median = 7.5 fish/100 m², range = 0.0 – 221.0 fish/100 m²), which averaged over 74% of all fishes captured in primary channels in previous years, was significantly lower than 2012 – 2014 densities (median 20.5 fish/100 m², range = 0.0 – 3,957.2 fish/100 m²; Wilcoxon signed-rank test: $P = 0.02$).

Only 125 fishes (total density = 24.6 fish/100 m²) were captured in secondary channels during 2015, of which 92% were native (Figure 15A). The low frequency of secondary channels in Reach 7 coupled with the relatively few number of years data (N = 4) makes it difficult to discern changes in densities and species compositions for secondary channels.

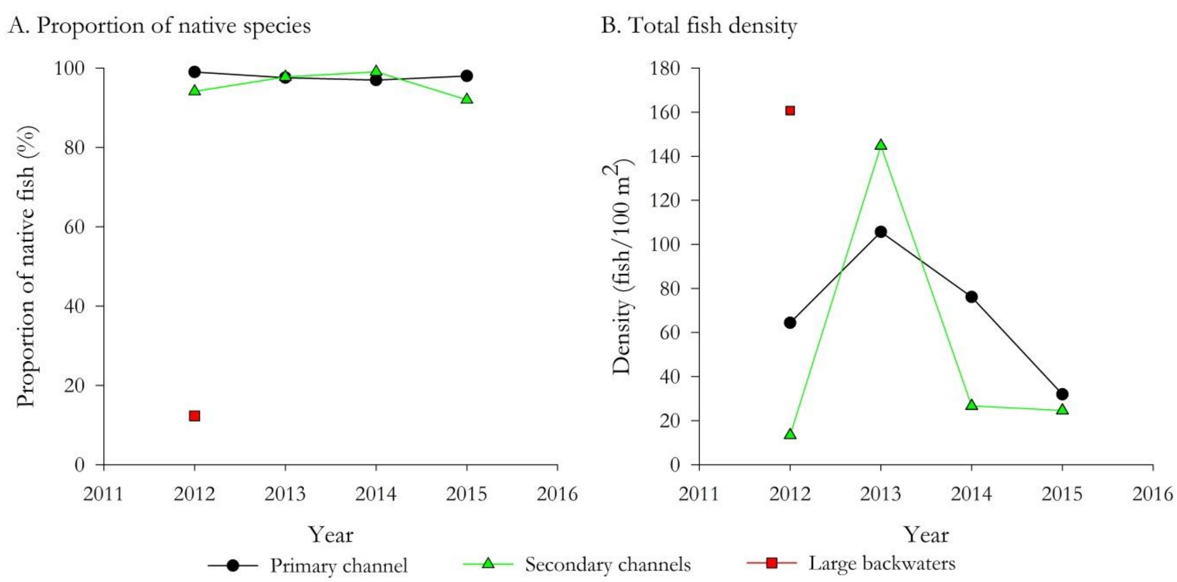


Figure 15. The (A) proportion (%) of native fishes and (B) total density (number/100 m²) of fishes captured in the primary channel (black circles), secondary channels (green triangles), and large backwaters (red squares) during small-bodied fish monitoring in Reach 7 of the San Juan River from 2012 – 2015.

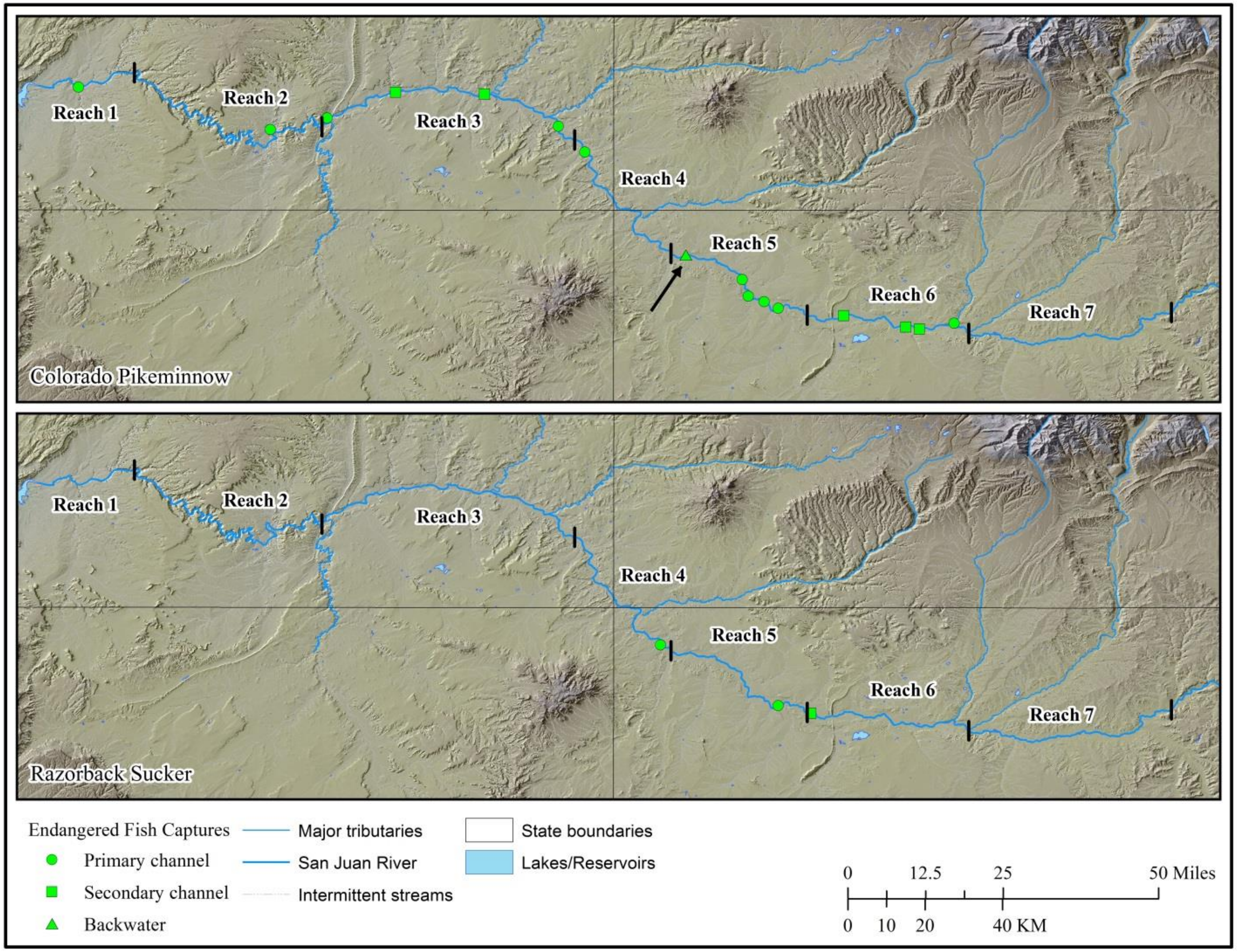


Figure 16. Location of Colorado Pikeminnow (top) and Razorback Sucker (bottom) captures during small-bodied fishes monitoring in the San Juan River in 2015. Arrow indicates location of wild age-0 Colorado Pikeminnow captured in a large backwater at River Mile 133.5.

Endangered Fishes

Colorado Pikeminnow

River-wide, 19 Colorado Pikeminnows were captured during 2015 small-bodied fishes monitoring (Figure 16). The river-wide median density in 2015 was 0.0 fish/100 m² (range = 0.0 – 6.2 fish/100 m²), but similar to previous years, the greatest number of Colorado Pikeminnow were captured in the common sampling area (Reaches 3 – 6), with the greatest densities occurring in Reaches 5 and 6 (Figure 17). One Colorado Pikeminnow was captured in both Reach 1 and 2, but none were captured in Reach 7 and none have ever been captured upstream of the confluence with the Animas River. Although variable, densities of Colorado Pikeminnow did not significantly vary among channel types in 2015 (Kruskal-Wallis ANOVA: P = 0.71; Figure 18).

The total length (TL) of captured Colorado Pikeminnows in 2015 ranged from 18 to 245 mm with an average of 138 mm. This is the third smallest average total length of captured Colorado Pikeminnow since 2007 (Appendix XIII). A single young-of-the-year (metalarvae stage; 18 mm TL) Colorado Pikeminnow was captured in a large backwater at River Mile 133.5 (Figure 16). This is the first confirmed wild age-0 Colorado Pikeminnow captured in the San Juan River during small-bodied fishes monitoring since it began in 1998. One Colorado Pikeminnow was a recapture and four others were large enough to be tagged at the time of capture.

Razorback Sucker

Three Razorback Suckers were captured river-wide during 2015, one each in Reach 4, 5, and 6 (Figure 16). This is the most Razorback Suckers captured during small-bodied monitoring, but all fish were large (> 405 mm TL) and had been previously tagged. Since small-bodied monitoring began in 1998, no age-0 or juvenile Razorback Suckers have been captured and all captures were fish that had been previously stocked during population augmentation efforts.

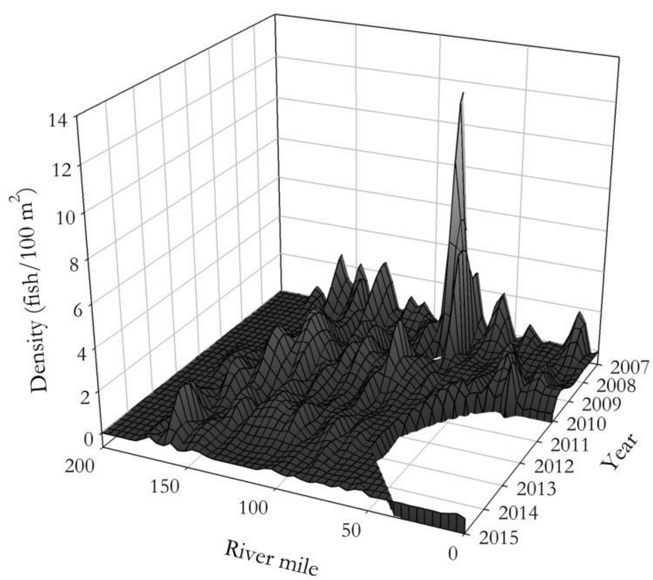


Figure 17. Density of Colorado Pikeminnow captured during small-bodied fishes monitoring in the San Juan River by river mile and year. Note that River Miles 181 – 213 (Reach 7) were not sampled before 2012 and River Miles 0 – 67 (Reaches 1 and 2) were not sampled from 2011 – 2014.

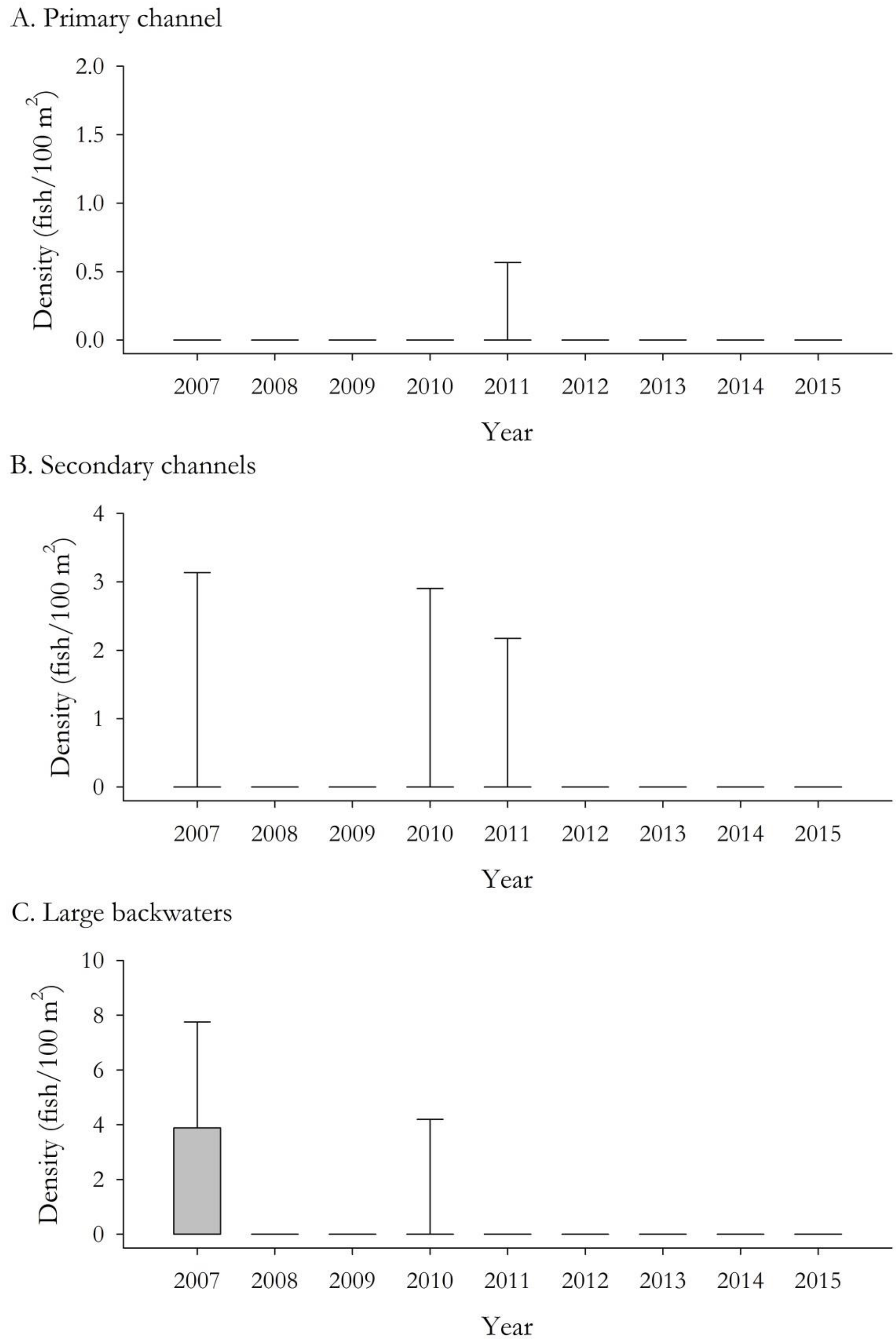


Figure 18. Box-whisker plots of river-wide densities of Colorado Pikeminnow in (A) the primary channel, (B) secondary channels, and (C) large backwaters of the San Juan River from 2007 – 2015. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile. Note that Y-axis scales differ between graphs and that River Miles 181 – 213 (Reach 7) was not sampled before 2012 and River Miles 0 – 67 (Reaches 1 and 2) were not sampled from 2011 - 2014.

River Ecosystem Restoration Initiative Secondary Channels

All River Ecosystem Restoration Initiative (RERI) and Reference secondary channels were sampled on September 18, 2015. Similar to 2014, very few of the RERI (N = 2) or Reference (N = 1) sites could be sampled (Table 3). Three of the RERI and two Reference sites were dry, but one of the dry Reference sites (located at RM 133.5) was sampled because a large backwater had formed where it rejoined the primary channel. Low discharge (551 cfs, USGS Shiprock, NM gage) during sampling in 2015 may have been the reason why few of the RERI and Reference secondary channels were flowing.

Due to low number of samples in 2014 and 2015, assessment of differences between RERI and Reference channels is difficult. Very few fish species were captured in RERI (N = 4) or Reference (N = 1) secondary channels in 2015 in comparison to previous years (2012 – 2013; Appendix XIV). Since 2012 though, density of nonnative species have decreased in both RERI and Reference secondary channels but native species density have remained stable (Figures 19 and 20). Species diversity in both channels have also decreased since 2012 but evenness has remained stable (Figure 21). Colorado Pikeminnows have been observed in both RERI and Reference channels since 2012, but none were captured in either channel type in 2015.

Table 3. Information for River Ecosystem Restoration Initiative (RERI) and Reference secondary channels sampled during small-bodied fishes monitoring in the San Juan River from 2012 - 2015.

		Sampled?			
Site Type	River Mile	2012	2013	2014	2015
Reference	134.3	Yes	No[3]	Yes	Yes
Reference	133.5	Yes	No[3]	No[1]	No[5]
RERI	132.2	Yes	Yes	Yes	No[1]
RERI	132	No[1]	Yes	No[1]	Yes
RERI	130.7A	Yes	Yes	No[1]	No[1]
RERI	130.7B	Yes	No[3]	Yes[4]	No[3]
Reference	130.1	Yes	Yes	Yes[4]	No[1]
RERI	128.6	No[2]	No[2]	No[1]	No1
RERI	127.2	Yes	Yes	No[1]	Yes
Reference	122.7	Yes	Yes	No[1]	No[2]

[1]Channel was dry

[2]Channel was unable to be located

[3]Channel flow exceeded secondary channel definition

[4]Sampled but no fish were captured

[5]Secondaey channel was mostly dry and sampled as a large backwater

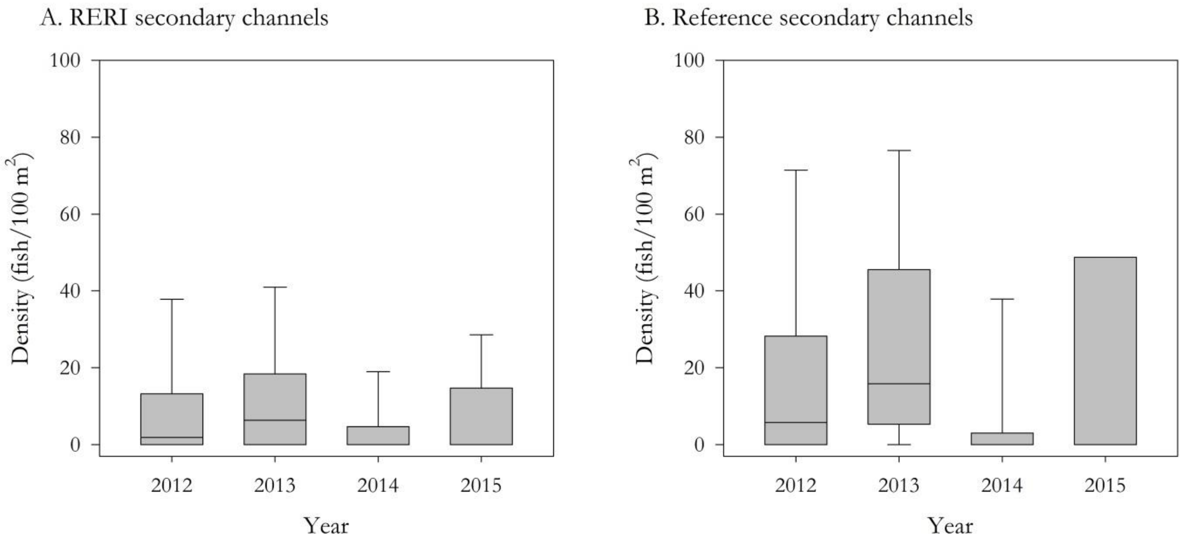


Figure 19. Box-whisker plots of native fish density in (A) River Ecosystems Restoration Initiative (RERI) and (B) Reference secondary channels of the San Juan River from 2012 – 2015. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile.

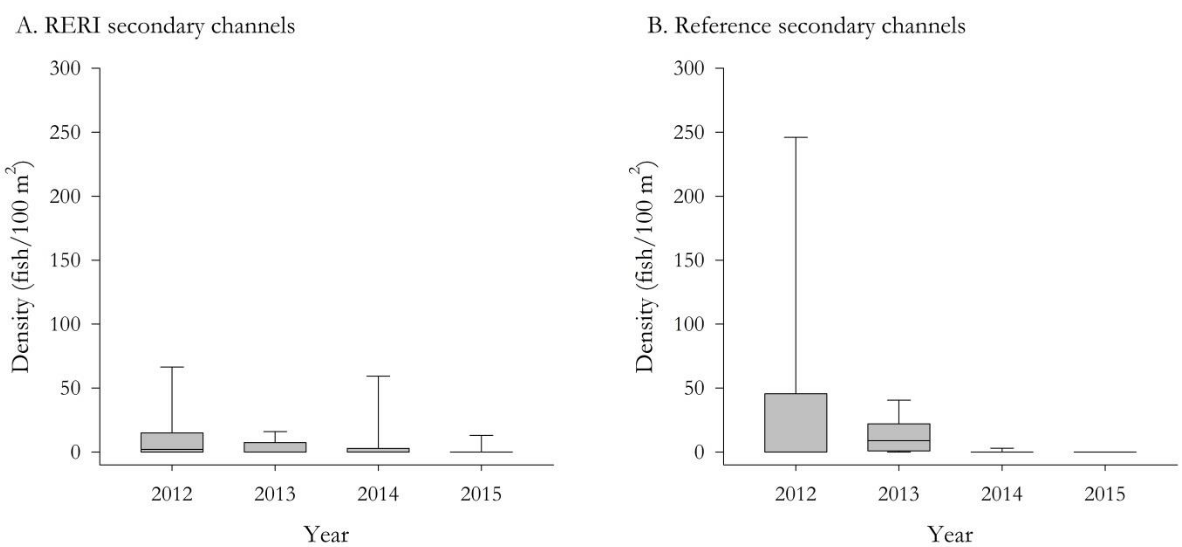


Figure 20. Box-whisker plots of nonnative fish density in (A) River Ecosystems Restoration Initiative (RERI) and (B) Reference secondary channels of the San Juan River from 2012 – 2015. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentile.

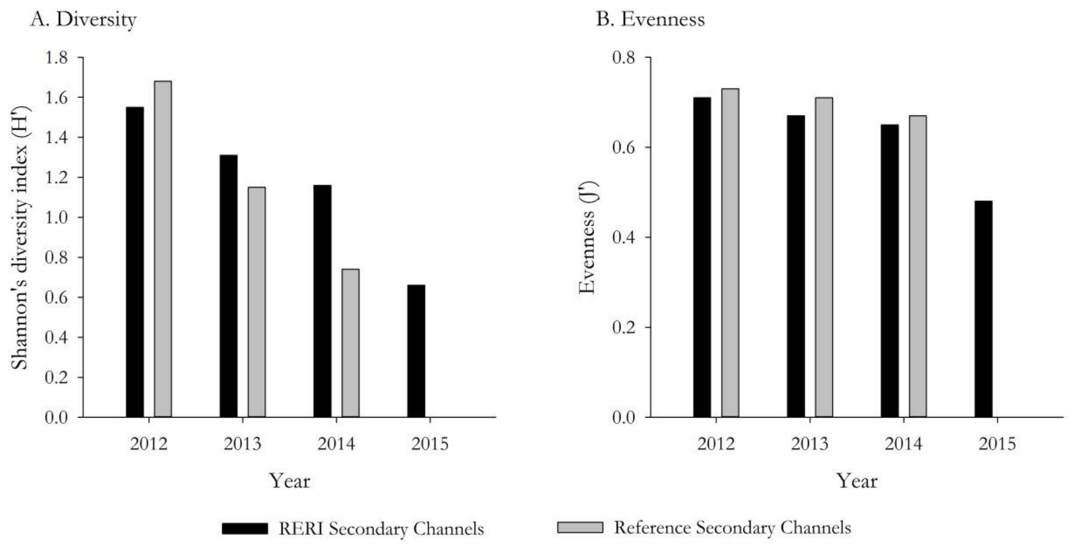


Figure 21. The (A) species diversity and (B) evenness of fishes captured in River Ecosystems Restoration Initiative (RERI) and reference secondary channels during small-bodied fishes monitoring in the San Juan River from 2012 – 2015.

SUMMARY

The fewest number of fishes ever captured during small-bodied monitoring since 2007 occurred in 2015. While the exact mechanism for the low numbers in 2015 is unknown, recent drought conditions in the basin likely played a part. The decreasing trends observed in native species since 2007 is not entirely surprising as previous research has indicated that fall abundance of common native species is correlated with high spring flows (Propst and Gido 2004) and that drought can have significant effects on native fish species (Propst e al. 2008). The decreasing trends in nonnative fishes are puzzling as low summer discharge and drought conditions have been shown to benefit invasive species (Propst and Gido 2004). Variability in flows, particularly during the summer, may also have had some effect on both native and nonnative species, as flow variability has been shown to affect both (Gido et al. 2013). Lack of high spring flows have also resulted in a decrease in habitat complexity over time in the San Juan River (Lamarra and Lamarra 2013), which may also be causing a decline in small-bodied fishes over time. Further investigation into the effects of flow variability and habitat complexity on small-bodied fishes in the San Juan River should be conducted given the longer dataset now available in comparison to previous studies (Propst and Gido 2004; Gido and Propst 2012).

Both endangered species and Roundtail Chub continue to be rare during small-bodied monitoring. Colorado Pikeminnows have been captured every year since 2007, but densities continue to be low and fairly consistent across years. The first wild age-0 Colorado Pikeminnow (18 mm TL) ever captured during small-bodied monitoring did occur in 2015 though. The back-calculated spawning date for this fish was mid-August, almost 5 weeks after back-calculated spawning dates for Colorado Pikeminnow captured during 2015 larval monitoring (M. Farrington, personal communication). Although recent studies have indicated that Colorado Pikeminnow spawn in the San Juan River during June and July (Farrington et al. 2015), a mid-August spawning date in the San Juan River has previously been observed (Platania 1990). All other Colorado

Pikeminnow captured during 2015 small-bodied monitoring were likely the result of augmentation efforts. Three Razorback Sucker were captured in 2015, but these were all large fish and no age-0 or juvenile Razorback Sucker have ever been captured during small-bodied monitoring. No Roundtail Chub were captured during small-bodied monitoring in 2015.

Continued annual small-bodied monitoring will be important for identifying recruitment of endangered fish species in the San Juan River. Furthermore, data collected during small-bodied monitoring are beneficial for tracking trends in both native and nonnative fish species. Further efforts to elucidate the effects of yearly flow variations on native and nonnative small-bodied fishes should be made to better understand the effects of drought on the San Juan River fish community.

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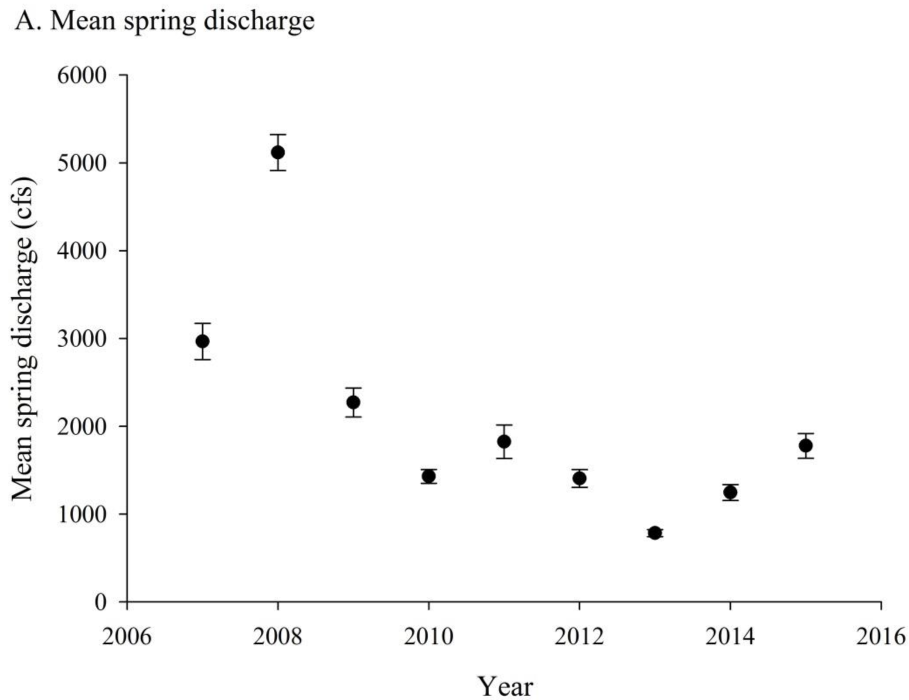
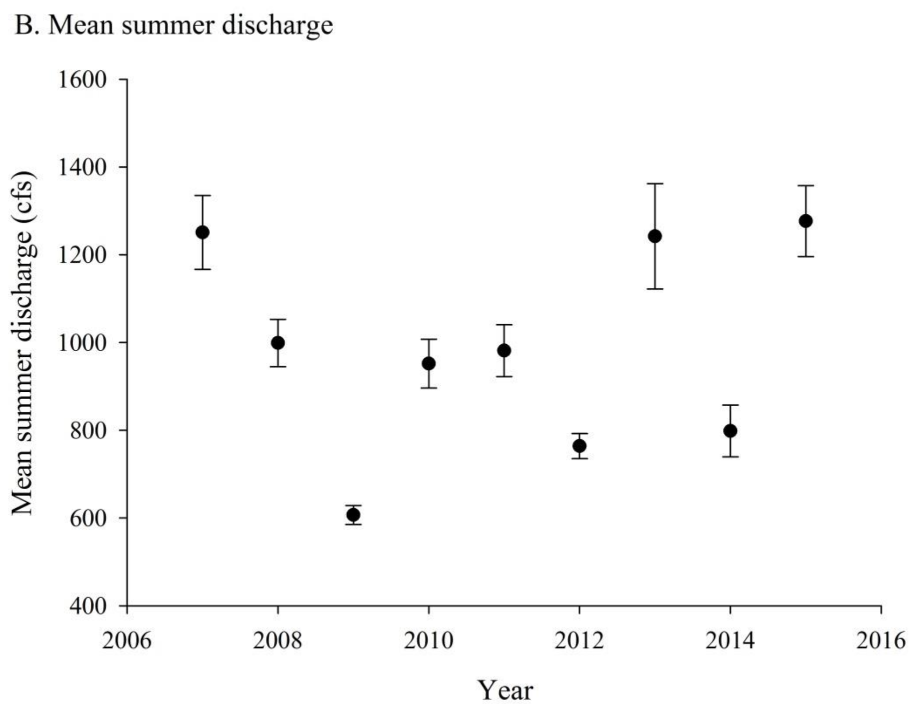
APPENDICES

Appendix I. Mean daily discharge (cubic feet/secong; cfs) and discharge attributes of the San Juan River at Shiprock, NM (USGS Gage 09368000) during spring (1 March - 30 June) and summer (1 July - 30 Septmber), 2007 -2015.

Spring Attributes	2007	2008	2009	2010	2011	2012	2013	2014	2004-2013	2015
March Mean	1276	4483	940	934	788	947	565	604	1317	945
April Mean	1244	3789	987	1177	692	1313	616	806	1328	614
May Mean	6050	4780	4163	1902	1167	2504	1301	1507	2922	1370
June Mean	3250	7450	2978	1708	4710	842	644	2082	2958	4225
Spring Mean	2967	5117	2272	1430	1825	1407	784	1246	2131	1778
Days Q>3,000	48	102	37	10	21	11	0	11	30	26
Days Q>5,000	21	47	20	0	11	7	0	0	13	6
Days Q>8,000	5	22	0	0	7	0	0	0	4	0
Days Q>10,000	0	4	0	0	0	0	0	0	1	0

Summer Attributes	2007	2008	2009	2010	2011	2012	2013	2014	2004-2013	2015
July Mean	1054	1463	816	833	1497	884	699	747	999	1607
August Mean	1518	740	536	1202	628	625	909	749	863	1442
Sept Mean	1178	787	464	817	814	784	2147	903	987	764
Summer Mean	1251	999	607	952	981	764	1242	798	949	1277
Days Q>5,000	0	0	0	0	0	0	1	0	0	0
Days Q>4,000	1	0	0	1	0	0	5	0	1	1
Days Q>3,000	6	0	0	1	0	0	8	2	2	3
Days Q>2,000	9	5	0	4	6	0	13	2	5	21
Days Q>1,000	41	37	4	20	32	13	33	17	25	43
Days Q<1,000	51	55	87	72	60	78	59	75	67	50
Days Q<750	13	41	79	41	48	58	42	58	48	36
Days Q<500	0	11	29	1	10	6	12	28	12	3





Appendix II. The (A) mean spring (1 March – 30 June) discharge and (B) mean summer (1 July – 30 September) discharge of the San Juan River at the USGS Shiprock, NM stream gage (09368000) from 2007 – 2015. Bars indicate ± 1 standard error.

Appendix III. Common name, scientific name, and six letter species code for fish species captured during small-bodied fish monitoring in the San Juan River. Bold type indicates species native to the San Juan River.

Common name	Scientific name	Six letter species code
Bluehead Sucker	***Catostomus discobolus***	**CATDIS**
Flannelmouth Sucker	***Catostomus latipinnis***	**CATLAT**
Mottled Sculpin	***Cottus bairdii***	**COTBAI**
Roundtail Chub	***Gila robusta***	**GILROB**
Colorado Pikeminnow	***Ptychocheilus lucius***	**PTYLUC**
Speckled Dace	***Rhinichthys osculus***	**RHIOSC**
Razorback Sucker	***Xyrauchen texanus***	**XYRTEX**
Black Bullhead	*Ameiurus melas*	AMEMEL
Yellow Bullhead	*Ameiurus natalis*	AMENAT
Common Carp	*Cyprinus carpio*	CYPCAR
Red Shiner	*Cyprinella lutrensis*	CYPLUT
Plains Killifish	*Fundulus zebrinus*	FUNZEB
Mosquitofish	*Gambusia affinis*	GAMAFF
Channel Catfish	*Ictalurus punctatus*	ICTPUN
Green Sunfish	*Lepomis cyanellus*	LEPCYA
Bluegill	*Lepomis macrochirus*	LEPMAC
Largemouth Bass	*Micropterus salmoides*	MICSAL
Rainbow Trout	*Oncorhynchus mykiss*	ONCMYK
Fathead Minnow	*Pimephales promelas*	PIMPRO
Brown Trout	*Salmo trutta*	SALTRU

Appendix IV. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in primary channels of reach 1 and 2 in the San Juan River from 2007 to 2015. Note that reach 1 and 2 were not sampled from 2011 to 2014. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2007			2008			2009			2010			2011		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS							3	0.0021	0.0014	2	0.0010	0.0008			
CATLAT	3	0.0017	0.0010	1	0.0004	0.0004				8	0.0027	0.0011			
COTBAI															
GILROB															
PTYLUC	4	0.0019	0.0010				2	0.0016	0.0012	2	0.0006	0.0004			
RHIOSC	43	0.0218	0.0050	28	0.0213	0.0069	14	0.0066	0.0021	52	0.0230	0.0078			
XYRTEX															
AMEMEL															
AMENAT															
CYPCAR				1	0.0009	0.0009									
CYPLUT	43	0.0235	0.0095	5	0.0029	0.0013	84	0.0311	0.0081	57	0.0199	0.0070			
FUNZEB															
GAMAFF							3	0.0011	0.0007						
ICTPUN	246	0.1060	0.0161	130	0.0670	0.0138	48	0.0304	0.0178	130	0.0501	0.0087			
LEPCYA							1	0.0002	0.0002						
LEPMAC															
MICSAL							1	0.0003	0.0003						
ONCMYK															
PIMPRO															
SALTRU															
Total N	339			165			156			251					
Total Area	2317			1746			2542			3170					
Total Density	0.1463			0.0945			0.0614			0.0792					

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS												
CATLAT										1	0.0001	0.0001
COTBAI												
GILROB												
PTYLUC										2	0.0002	0.0002
RHIOSC										11	0.0024	0.0010
XYRTEX												
AMEMEL												
AMENAT												
CYPCAR												
CYPLUT												
FUNZEB												
GAMAFF										1	0.0001	0.0001
ICTPUN										76	0.0119	0.0022
LEPCYA												
LEPMAC												
MICSAL												
ONCMYK												
PIMPRO												
SALTRU												
Total N										91		
Total Area										6925		
Total Density										0.0131		

Appendix V. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in secondary channels of reach 1 and 2 in the San Juan River from 2007 to 2015. Note that reach 1 and 2 were not sampled from 2011 to 2014. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2007			2008			2009			2010			2011		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS															
CATLAT															
COTBAI															
GILROB															
PTYLUC	1	0.0186	0.0186												
RHIOSC							4	0.1818	0.1818	2	0.1550	0.1550			
XYRTEX															
AMEMEL															
AMENAT															
CYPCAR															
CYPLUT	5	0.0931	0.0931				1	0.0246	0.0246						
FUNZEB															
GAMAFF							9	0.2211	0.2211						
ICTPUN	8	0.1723	0.0978				11	0.3579	0.2292	7	0.2772	0.1415			
LEPCYA															
LEPMAC															
MICSAL															
ONCMYK															
PIMPRO															
SALTRU															
Total N	14						25			9					
Total Area	49			0			44			43					
Total Density	0.2854						0.5682			0.2071					

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS												
CATLAT												
COTBAI												
GILROB												
PTYLUC												
RHIOSC												
XYRTEX												
AMEMEL												
AMENAT												
CYPCAR												
CYPLUT												
FUNZEB												
GAMAFF												
ICTPUN												
LEPCYA												
LEPMAC												
MICSAL												
ONCMYK												
PIMPRO												
SALTRU												
Total N												
Total Area										0		
Total Density												

Appendix VI. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in large backwaters of reach 1 and 2 in the San Juan River from 2007 to 2015. Note that reach 1 and 2 were not sampled from 2011 to 2014.Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2007			2008			2009			2010			2011		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS															
CATLAT															
COTBAI															
GILROB															
PTYLUC	1	0.0076	0.0076							1	0.0087	0.0087			
RHIOSC															
XYRTEX															
AMEMEL															
AMENAT															
CYPCAR															
CYPLUT										3	0.0126	0.0066			
FUNZEB															
GAMAFF				19	0.5346	0.4313	1	0.0189	0.0189						
ICTPUN	10	0.0960	0.0607	1	0.0258	0.0258	2	0.0413	0.0413	2	0.0078	0.0062			
LEPCYA															
LEPMAC															
MICSAL															
ONCMYK															
PIMPRO															
SALTRU															
Total N	11			20			3			6					
Total Area	125			37			51			258					
Total Density	0.0877			0.5411			0.0593			0.0233					

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS												
CATLAT												
COTBAI												
GILROB												
PTYLUC												
RHIOSC												
XYRTEX												
AMEMEL												
AMENAT												
CYPCAR												
CYPLUT												
FUNZEB												
GAMAFF												
ICTPUN												
LEPCYA												
LEPMAC												
MICSAL												
ONCMYK												
PIMPRO												
SALTRU												
Total N												
Total Area										0		
Total Density												

Appendix VII. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in primary channels of reaches 3 - 6 in the San Juan River from 2007 to 2015. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2007			2008			2009			2010			2011		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	54	0.0087	0.0022	60	0.0090	0.0042	245	0.0436	0.0106	199	0.0283	0.0088	33	0.0062	0.0022
CATLAT	146	0.0199	0.0039	105	0.0173	0.0053	217	0.0377	0.0117	594	0.0832	0.0258	104	0.0115	0.0021
COTBAI															
GILROB															
PTYLUC	20	0.0029	0.0010	3	0.0005	0.0003	8	0.0012	0.0005	26	0.0037	0.0010	38	0.0045	0.0011
RHIOSC	2112	0.3420	0.0494	1178	0.2611	0.0314	2963	0.6507	0.0849	1960	0.2805	0.0445	659	0.1600	0.0264
XYRTEX															
AMEMEL				1	0.0007	0.0007							4	0.0005	0.0004
AMENAT										4	0.0011	0.0008			
CYPCAR				1	0.0005	0.0005	1	0.0002	0.0002						
CYPLUT	166	0.0331	0.0089	173	0.0357	0.0092	2482	0.6283	0.1351	164	0.0215	0.0053	250	0.0403	0.0085
FUNZEB				2	0.0002	0.0001	13	0.0013	0.0013	3	0.0003	0.0002	2	0.0006	0.0004
GAMAFF	8	0.0016	0.0012	5	0.0008	0.0004	27	0.0047	0.0021	3	0.0005	0.0004	44	0.0093	0.0048
ICTPUN	483	0.0768	0.0137	391	0.0701	0.0111	66	0.0119	0.0034	325	0.0563	0.0119	512	0.0655	0.0105
LEPCYA				1	0.0001	0.0001	6	0.0012	0.0007	1	0.0001	0.0001	2	0.0003	0.0002
LEPMAC													1	0.0002	0.0002
MICSAL	1	0.0006	0.0006				3	0.0009	0.0006				1	0.0004	0.0004
ONCMYK															
PIMPRO	32	0.0054	0.0034	25	0.0072	0.0049	64	0.0138	0.0076	12	0.0019	0.0011	3	0.0004	0.0002
SALTRU							1	0.0002	0.0002	2	0.0002	0.0001			
Total N	3022			1945			6096			3293			1653		
Total Area	6955			5616			5885			8117			10546		
Total Density	0.4345			0.3463			1.0358			0.4057			0.1567		

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	120	0.0187	0.0069	145	0.0222	0.0062	38	0.0049	0.0014	70	0.0144	0.0084
CATLAT	260	0.0582	0.0349	370	0.0522	0.0134	85	0.0124	0.0055	74	0.0085	0.0020
COTBAI												
GILROB	1	0.0001	0.0001									
PTYLUC	25	0.0017	0.0006	11	0.0018	0.0007	19	0.0025	0.0009	10	0.0010	0.0004
RHIOSC	995	0.2213	0.0680	1402	0.2604	0.0374	335	0.0656	0.0136	329	0.0583	0.0236
XYRTEX										2	0.0002	0.0001
AMEMEL										1	0.0003	0.0003
AMENAT												
CYPCAR				1	0.0002	0.0002	1	0.0002	0.0002			
CYPLUT	413	0.0606	0.0153	39	0.0098	0.0039	61	0.0089	0.0041	15	0.0017	0.0011
FUNZEB	18	0.0019	0.0011	5	0.0013	0.0010	3	0.0002	0.0001	2	0.0001	0.0001
GAMAFF	158	0.0342	0.0116	16	0.0035	0.0016	7	0.0008	0.0005	67	0.0158	0.0118
ICTPUN	105	0.0105	0.0026	303	0.0602	0.0118	73	0.0080	0.0015	23	0.0017	0.0006
LEPCYA	1	0.0001	0.0001							3	0.0006	0.0006
LEPMAC										1	0.0003	0.0003
MICSAL	3	0.0003	0.0003				1	0.0002	0.0002	2	0.0006	0.0006
ONCMYK												
PIMPRO	31	0.0055	0.0029	26	0.0039	0.0019	37	0.0045	0.0023	26	0.0054	0.0036
SALTRU	1	0.0000	0.0000	2	0.0003	0.0002						
Total N	2131			2320			660			625		
Total Area	15331			7059			8750			9902		
Total Density	0.1390			0.3286			0.0754			0.0631		

Appendix VIII. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in secondary channels of reaches 3 - 6 in the San Juan River from 2007 to 2015. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2007			2008			2009			2010			2011		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	13	0.0063	0.0027	43	0.0105	0.0059	102	0.0371	0.0100	173	0.0563	0.0175	220	0.0859	0.0406
CATLAT	86	0.0433	0.0217	194	0.0570	0.0284	78	0.0287	0.0091	288	0.1355	0.0496	65	0.0269	0.0065
COTBAI															
GILROB													1	0.0007	0.0007
PTYLUC	15	0.0095	0.0031	6	0.0017	0.0009	1	0.0004	0.0004	18	0.0069	0.0019	21	0.0075	0.0028
RHIOSC	819	0.4585	0.1098	1040	0.4604	0.0982	1068	0.5022	0.1171	886	0.3667	0.0959	559	0.3734	0.0716
XYRTEX															
AMEMEL				3	0.0010	0.0008	1	0.0009	0.0009				9	0.0060	0.0042
AMENAT				3	0.0016	0.0011	5	0.0023	0.0016						
CYPCAR				5	0.0028	0.0014	4	0.0018	0.0009						
CYPLUT	163	0.0719	0.0204	294	0.0930	0.0506	1716	0.9593	0.2951	378	0.1104	0.0668	197	0.0996	0.0406
FUNZEB				4	0.0021	0.0013				1	0.0004	0.0004	16	0.0049	0.0037
GAMAFF	1	0.0004	0.0004	79	0.0226	0.0083	27	0.0147	0.0067	28	0.0130	0.0082	221	0.0612	0.0426
ICTPUN	216	0.0948	0.0171	110	0.0390	0.0116	42	0.0242	0.0093	116	0.0542	0.0130	184	0.1006	0.0212
LEPCYA							2	0.0006	0.0006				3	0.0009	0.0005
LEPMAC															
MICSAL				10	0.0047	0.0024	6	0.0042	0.0023	2	0.0005	0.0004	6	0.0025	0.0016
ONCMYK															
PIMPRO	4	0.0018	0.0018	116	0.0356	0.0177	19	0.0112	0.0057	50	0.0294	0.0183	22	0.0059	0.0039
SALTRU															
Total N	1317			1907			3071			1940			1524		
Total Area	2408			3263			2403			2760			2412		
Total Density	0.5470			0.5845			1.2782			0.7028			0.6318		

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	45	0.0261	0.0086	35	0.0145	0.0065	10	0.0024	0.0011	47	0.0246	0.0167
CATLAT	203	0.0707	0.0237	148	0.0492	0.0171	63	0.0137	0.0035	72	0.0157	0.0032
COTBAI												
GILROB	1	0.0006	0.0006				2	0.0010	0.0009			
PTYLUC	2	0.0005	0.0003	5	0.0017	0.0008	9	0.0018	0.0007	6	0.0010	0.0004
RHIOSC	211	0.0944	0.0169	596	0.2838	0.0592	212	0.0803	0.0187	210	0.0514	0.0084
XYRTEX				1	0.0003	0.0003				1	0.0002	0.0002
AMEMEL	1	0.0019	0.0019									
AMENAT	3	0.0029	0.0025				2	0.0006	0.0004	1	0.0008	0.0008
CYPCAR				1	0.0002	0.0002						
CYPLUT	336	0.1431	0.0324	43	0.0169	0.0045	24	0.0051	0.0021	5	0.0009	0.0006
FUNZEB	2	0.0005	0.0003									
GAMAFF	329	0.1606	0.0701	12	0.0039	0.0018	3	0.0006	0.0004	26	0.0149	0.0105
ICTPUN	14	0.0049	0.0020	187	0.0739	0.0136	101	0.0303	0.0076	14	0.0032	0.0013
LEPCYA	2	0.0026	0.0026							3	0.0029	0.0022
LEPMAC												
MICSAL	6	0.0017	0.0011									
ONCMYK												
PIMPRO	74	0.0381	0.0240	5	0.0017	0.0009	2	0.0004	0.0003	2	0.0006	0.0005
SALTRU												
Total N	1229			1033			428			387		
Total Area	3760			2973			4133			5568		
Total Density	0.3269			0.3475			0.1036			0.0695		

Appendix IX. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in large backwaters of reaches 3 - 6 in the San Juan River from 2007 to 2015. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2007			2008			2009			2010			2011		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	1	0.0017	0.0017	6	0.0132	0.0055	26	0.0272	0.0128				1153	1.1560	0.9027
CATLAT	3	0.0053	0.0040	25	0.0641	0.0316	30	0.0344	0.0159	56	0.1221	0.0505	15	0.0108	0.0053
COTBAI															
GILROB															
PTYLUC	18	0.0404	0.0246	1	0.0028	0.0028	1	0.0007	0.0007	2	0.0048	0.0037	2	0.0024	0.0021
RHIOSC	28	0.0636	0.0257	110	0.1992	0.1157	38	0.0430	0.0147	19	0.0608	0.0433	105	0.0895	0.0284
XYRTEX															
AMEMEL							121	0.0859	0.0848	8	0.0180	0.0125	44	0.0378	0.0273
AMENAT	1	0.0048	0.0048				1	0.0011	0.0011	1	0.0015	0.0015	1	0.0007	0.0007
CYPCAR	1	0.0054	0.0054	2	0.0054	0.0039	3	0.0031	0.0018	1	0.0035	0.0035			
CYPLUT	61	0.1329	0.0525	288	0.5854	0.5070	2103	1.8936	0.5661	197	0.3257	0.1397	2694	3.4959	2.3718
FUNZEB				1	0.0034	0.0034				3	0.0098	0.0085	11	0.0086	0.0058
GAMAFF				4	0.0115	0.0095	433	0.4094	0.3256	25	0.0342	0.0259	169	0.2435	0.1161
ICTPUN	23	0.0454	0.0223	37	0.0853	0.0381	5	0.0055	0.0039	9	0.0116	0.0084	19	0.0195	0.0125
LEPCYA				1	0.0031	0.0031	91	0.0793	0.0788				1	0.0007	0.0007
LEPMAC															
MICSAL				6	0.0161	0.0116	21	0.0197	0.0156						
ONCMYK															
PIMPRO	12	0.0222	0.0148	34	0.1141	0.0691	183	0.1387	0.0646	24	0.0615	0.0428	88	0.0678	0.0589
SALTRU															
Total N	148			515			3056			345			4302		
Total Area	457			449			969			471			1213		
Total Density	0.3237			1.1475			3.1522			0.7328			3.5470		

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	1	0.0019	0.0019	22	0.0634	0.0389	35	0.0263	0.0192	29	0.0440	0.0310
CATLAT	1	0.0019	0.0019	95	0.2617	0.1353	15	0.0232	0.0113	1	0.0013	0.0013
COTBAI												
GILROB												
PTYLUC										1	0.0020	0.0020
RHIOSC	8	0.0183	0.0090	66	0.2945	0.1710	30	0.0287	0.0142	58	0.1018	0.0397
XYRTEX												
AMEMEL												
AMENAT												
CYPCAR												
CYPLUT	218	0.8637	0.6768	6	0.0258	0.0173	99	0.1385	0.1370	19	0.0300	0.0143
FUNZEB	11	0.0150	0.0117	4	0.0161	0.0093	2	0.0017	0.0017	11	0.0069	0.0058
GAMAFF	921	1.4095	0.4277	17	0.0750	0.0657	25	0.0388	0.0250	10	0.0142	0.0080
ICTPUN							1	0.0023	0.0023			
LEPCYA	9	0.0325	0.0241									
LEPMAC												
MICSAL												
ONCMYK												
PIMPRO	111	0.2803	0.1533	189	0.4812	0.4192	62	0.1477	0.1179	3	0.0050	0.0028
SALTRU												
Total N	1280			399			269			132		
Total Area	623			347			787			705		
Total Density	2.0548			1.1486			0.3420			0.1872		

Appendix X. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in primary channels of reach 7 in the San Juan River from 2007 to 2015. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

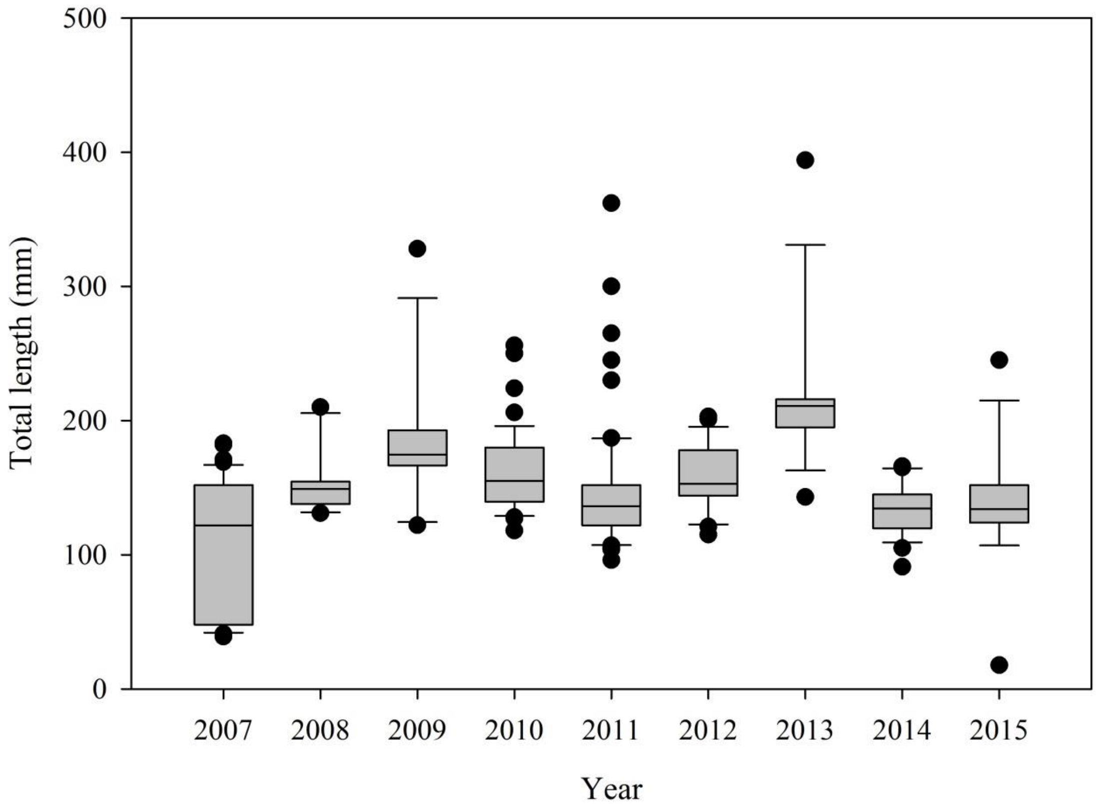
	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	25	0.0290	0.0119	42	0.0630	0.0316	80	0.1210	0.0319	19	0.0198	0.0065
CATLAT	15	0.0321	0.0190	293	0.4766	0.2696	116	0.1416	0.0479	60	0.0842	0.0488
COTBAI	1			1	0.0011	0.0011						
GILROB												
PTYLUC												
RHIOSC	556	1.4234	0.8878	510	0.7847	0.2702	544	0.6583	0.1119	217	0.2363	0.0744
XYRTEX												
AMEMEL												
AMENAT												
CYPCAR												
CYPLUT							2	0.0024	0.0024			
FUNZEB				1	0.0015	0.0015	2	0.0015	0.0011			
GAMAFF	1	0.0069	0.0068	5	0.0075	0.0075	2	0.0017	0.0017			
ICTPUN												
LEPCYA	1	0.0069	0.0068	1	0.0008	0.0008						
LEPMAC												
MICSAL												
ONCMYK	1	0.0025	0.0024									
PIMPRO	2	0.0138	0.0095	12	0.0179	0.0179	16	0.0141	0.0069	6	0.0108	0.0078
SALTRU	1	0.0008	0.0008	2	0.0060	0.0042	1	0.0009	0.0009			
Total N	603			867			763			302		
Total Area	937			821			1003			947		
Total Density	0.6438			1.0565			0.7607			0.3191		

Appendix XI. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in secondary channels of reach 7 in the San Juan River from 2007 to 2015. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	4	0.1355	0.1291	56	0.1567	0.0554	10	0.0404	0.0264	12	0.0513	0.0337
CATLAT				146	0.4791	0.2010	19	0.0765	0.0516	16	0.0309	0.0138
COTBAI												
GILROB												
PTYLUC												
RHIOSC	12	0.5225	0.4450	242	0.7632	0.2094	77	0.3156	0.1411	87	0.2060	0.0540
XYRTEX												
AMEMEL				1	0.0021	0.0021						
AMENAT												
CYPCAR												
CYPLUT												
FUNZEB										5	0.0333	0.0333
GAMAFF										4	0.0216	0.0200
ICTPUN												
LEPCYA												
LEPMAC												
MICSAL												
ONCMYK												
PIMPRO	1	0.0433	0.0433	8	0.0228	0.0205	1	0.0014	0.0014	1	0.0022	0.0022
SALTRU				1	0.0048	0.0048						
Total N	17			454			107			125		
Total Area	127			314			401			508		
Total Density	0.1339			1.4472			0.2669			0.2459		

Appendix XII. Number of fish captured (N), mean density (fish/m2), and standard error (SE) of fish captured in large backwaters of reach 7 in the San Juan River from 2007 to 2015. Bold type indicates fish species native to the San Juan River. Total density was calculated as the total number of fish captured divided by the total area sampled for each year.

	2012			2013			2014			2015		
Species	N	Density	SE	N	Density	SE	N	Density	SE	N	Density	SE
CATDIS	12	0.0797	0.0797									
CATLAT												
COTBAI												
GILROB												
PTYLUC												
RHIOSC	3	0.0265	0.0153									
XYRTEX												
AMEMEL												
AMENAT												
CYPCAR												
CYPLUT												
FUNZEB	4	0.0266	0.0266									
GAMAFF	66	4.9309	4.9220									
ICTPUN												
LEPCYA												
LEPMAC												
MICSAL												
ONCMYK												
PIMPRO	37	0.2459	0.2459									
SALTRU												
Total N	122											
Total Area	76			0			0			0		
Total Density	1.6074											



Appendix XIII. Box whisker plot of total lengths (mm) of Colorado Pikeminnow captured river-wide in the San Juan River from 2007 to 2015. Boundary of the box closest to 0 indicates the 25th percentile, lines within a box indicate the median, and the boundary of the box furthest from 0 indicates the 75th percentile. Whiskers indicate the 10th and 90th percentiles and circles indicate outliers. Note that reaches 1 and 2 were not sampled from 2011 to 2014 and reach 7 was not sampled before 2012.

Appendix XIV. Number of species and density (fish/m^2) for natives and nonnatives, Shannon's Diversity Index (H'), and Evenness Based on Shannon's Index (J') for fishes captured in Reference and River Ecosystem Restoration Initiative secondary channels during small-bodied fishes monitoring in the San Juan River from 2012 - 2015.

	Natives		Nonnatives			
Year	Species	Density	Species	Density	Shannon's Diversity Index (H')	Evenness (J')
Reference channels						
2012	4	0.1746	6	1.0213	1.68	0.73
2013	3	0.2475	2	0.1290	1.15	0.71
2014	2	0.0584	1	0.0043	0.74	0.67
2015	1	0.1626	0	0	0	0
RERI channels						
2012	4	0.1712	5	0.2086	1.55	0.71
2013	4	0.1147	3	0.0395	1.31	0.67
2014	3	0.0422	3	0.0978	1.16	0.65
2015	2	0.0717	2	0.0176	0.66	0.48